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NATIONAL DAM INSPECTION PROGRAM. SAND SPRING RUN DAM. (NDS I.D.--ETC(U)
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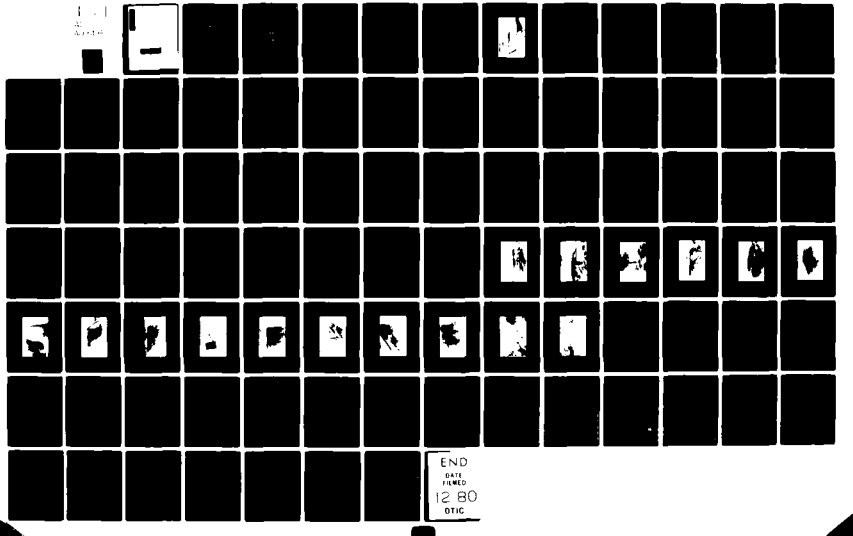

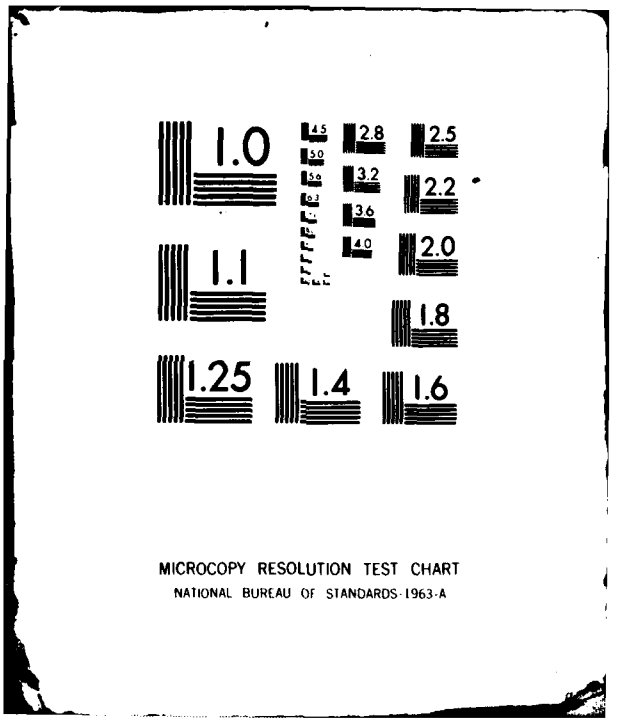
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DELAWARE RIVER BASIN

(6) National Dam Inspection Program.

SAND SPRING RUN DAM [redacted]

Number

(NDS I.D. [redacted] PA 00614,
DER I.D. [redacted] 13-90)

Delaware River Basin, Sand Spring Run, Carbon County, Pennsylvania.

PHASE I INSPECTION REPORT

[redacted]

(10) Mary F. Beck
John H. Frederick, Jr

(11) Aug 80

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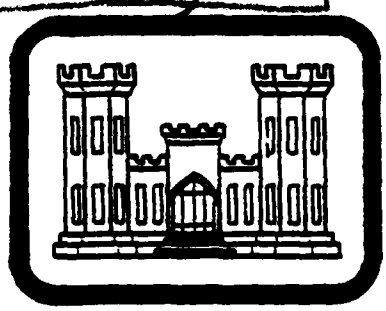

(15) DACW31-80-C-0018

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Submitted to:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

AUGUST 1980

394157

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Sand Spring Run Dam
County Located:	Carbon County
State Located:	Pennsylvania
Stream:	Sand Spring Run
Coordinates:	Latitude 41° 1.6'
	Longitude 75° 41.2'
Date of Inspection:	June 12, 1980

Sand Spring Run Dam is a recreational structure located in Hickory Run State Park and owned by the Commonwealth of Pennsylvania. The visual inspection and review of design and construction documentation indicate that the embankment and outlet structure are in good condition, the concrete weir is in fair condition, and the vegetation is in poor condition. The overall assessment is considered to be fairly good at the present time.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Small" size dam and "Significant" hazard potential classification is the 100 Year Flood to one-half the Probable Maximum Flood (PMF). As the dam's total capacity is nearer the lower limit of the size classification and because of the limited number of occupied structures downstream, the 100 Year Event would be an adequate spillway design flood. However, one-half the PMF has been used in this case because of the actual spillway capacity. Hydrologic and hydraulic computations presented in Appendix D indicate the spillway is capable of passing the full PMF without overtopping the embankment, resulting in an "Adequate" spillway classification for this dam.

It is recommended that the following measures be undertaken as soon as practical.

(1) The deteriorated surficial concrete of the weir should be repaired. All open cracks in the concrete should be sealed to prevent damage from freezing water.

(2) Damage to the downstream face of the embankment resulting from foot traffic and erosion should be repaired.

(3) In conjunction with (2), consideration should be given to the installation of three sets of steps up the downstream slope to reduce future damage to the embankment.

(4) Seepage existing adjacent to the outlet structure and downstream of the dam should be monitored for turbidity or an increase in volume.

The operation and maintenance manual was reviewed, and it is recommended that procedures concerning vegetation be expanded to include recommendations for maintaining a good stand of vegetation. It is also important to note that people responsible for operation and maintenance of the dam be familiar with the manual. Because of the location of the dam above the park headquarters with the potential for property damage and few or no live lost in the event of high flows or failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented for this facility.

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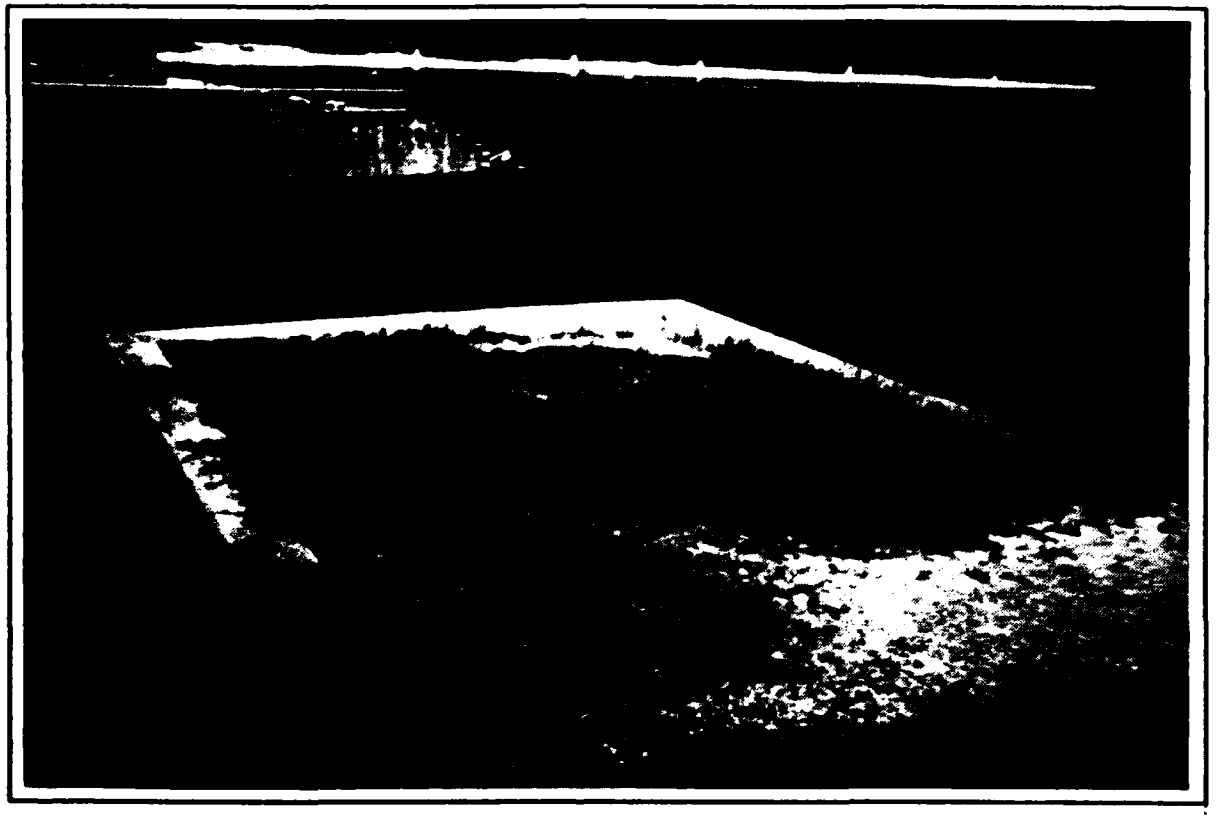
APPROVED BY:

James W. Peck — 5 Sep 80

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date



OVERVIEW
SAND SPRING RUN DAM, HICKORY RUN STATE PARK, KIDDER TOWNSHIP, CARBON COUNTY, PENNSYLVANIA

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SAND SPRING RUN DAM
NATIONAL ID NO. PA 00614
DER NO. 13-90

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Sand Spring Run Dam is an 18.5 foot high zoned earth embankment about 775 feet long, impounding a 139 acre-foot reservoir with water to the top of the dam. The upstream face was designed to be protected by three feet of dumped riprap over a nine inch gravel bedding from the crest to the toe on a slope of 2.5H:1V. Riprap adjacent to the spillway and at the right end of the dam has been replaced with large derrick stone; see Photograph 5. Design drawings indicate that the upstream portion of the embankment was constructed of random fill materials. The central portion of the dam, including the cutoff trench, was constructed of relatively impervious materials. The cutoff trench has a base width of 15 feet, and upstream and downstream slopes of 1.5H:1V. The limits of the cutoff trench are unknown; reports in state files indicate the cutoff trench was eliminated under the embankment across the valley bottom. The downstream portion was constructed of random materials over a dumped riprap toe drain. The toe drain is three feet deep with an average width of ten feet. The drawings do not include a plan view of the toe drain and do not indicate a drain outlet. The downstream face of the dam is on a slope of 2H:1V, and is protected by grass and miscellaneous vegetation.

An 88 foot wide concrete weir at elevation 1,500 is located at the left end of the embankment. Discharge over the

weir flows through a channel excavated through rock. The spillway channel deflects to the right through a 45 degree angle and tapers to 60 feet wide at a point about 130 feet downstream of the weir; see Plate 4, Appendix E. For about 100 feet downstream of the weir, the discharge channel has a slope of 0.06. The channel bed slope then increases to 1.5H:1V to an elevation of 1,479. About 34 feet farther downstream, the channel slope becomes adverse (uphill) at 6H:1V until it reaches elevation 1,484. About 360 feet downstream of the weir, the spillway discharges into the original stream channel; see Plate 4, Appendix E.

The outlet works are located at Dam Station 6+91.2, 75 feet right of the spillway. The outlet works consist of an upstream channel excavated from the original stream bed to the inlet at elevation 1,489.0, an inlet at the upstream toe protected with a trash rack, 20 feet of 24 inch cast iron pipe to the tower located at the upstream edge of the dam crest, and 53 feet of 24 inch cast iron pipe between the tower and the outlet structure. The outlet structure is shown in Photograph 3, Appendix C, and the entire system is shown on Plate 4, Appendix E. One anti-seep collar is located upstream of the tower, and four are between the tower and outlet. The unseating head sluice gate is located at the downstream end of the inlet pipe within the control tower. The outlet conduit invert is at elevation 1,488.4, and flow discharges through a concrete channel 12 feet long to a channel excavated through the rock. The excavated channel joins the main spillway channel about 90 feet downstream of the concrete outlet structure.

About 415 feet right of the spillway, the embankment deflects upstream through an angle of 41.5 degrees. At about Dam Station 2+30, the crest width increases from 15 feet until the width transitions into natural ground contours. The swimming beach is located on the right side of the reservoir adjacent to the end of the dam.

b. Location. The dam is located on Sand Spring Run in Kidder Township, Carbon County, Pennsylvania. The dam site is located in Hickory Run State Park, approximately three miles south of the intersection of the Northeast Extension of the Pennsylvania Turnpike and Interstate 80. The site is shown on the USGS Quadrangle entitled "Hickory Run, Pennsylvania" at coordinates N 41° 1.6' W 75° 41.2'. A regional location plan of Sand Spring Run Dam is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as a "Small" size structure by virtue of its 139 acre-foot total storage capacity and less than 40 foot height.

d. Hazard Classification. A "Significant" hazard classification is assigned consistent with the potential for appreciable economic damage, but with few lives lost.

e. Ownership. The dam is owned by the Commonwealth of Pennsylvania. All correspondence should be addressed to Bureau of Operations, Department of Environmental Resources, Post Office Box 1467, Harrisburg, Pennsylvania 17120.

f. Purpose of Dam. The dam and reservoir are used for recreational purposes.

g. Design and Construction History. In 1948, preliminary studies were made to determine the feasibility of a dam and reservoir at the site. Measurements of flow in Sand Spring Run and calculated evaporation losses disclosed that the yield was sufficient to maintain a pool even in the driest summers. In 1950, the Department of Forests and Waters proceeded with the design and preparation of construction drawings and specifications for the dam. Construction of the dam was under the supervision of the General State Authority. In February, Sprague & Henwood, Inc., contracted to drill six test borings for the proposed dam. The test boring program began towards the end of February 1950, and was completed by March 7, 1950, with only three borings drilled.

On June 30, 1950, application was made for a construction permit. The permit was issued on July 12, 1950, and construction began in that month by the Marshall Construction Company of Harrisburg, Pennsylvania.

Letters and memoranda located in the state files document the construction progress and occasional changes that were made. A memorandum of September 11, 1950, indicates that no cutoff trench would be required under the embankment across the valley bottom since, after stripping, the silty soil across the valley bottom was observed to be stable. The outlet conduit was designed to be founded on rock. When the initial excavation for the outlet conduit failed to uncover the uniform sound rock anticipated, the 24 inch outlet pipe cradle was reinforced and the conduit downstream of the control tower rests on hard conglomerate bedrock, while upstream, the pipe and cradle rest on sand, clay, gravel and boulder formation.

The contractor stripped and stored all available topsoil for placement on the completed embankment. However, only 300 cubic yards of very poor grade topsoil were available, rather than the required 650 cubic yards. Permission was granted to seed, fertilize and mulch the construction materials on the downstream face of the dam instead of placing topsoil.

An October 17 memorandum in the state files indicates that the contractor failed to follow specifications when constructing the embankment in the vicinity of the original stream bed. The state inspector charged that the contractor had dumped three to four feet of fill including rocks greater than six inches, the maximum permissible dimension, into a foundation of "soupy consistency", compacting only with a Caterpillar tractor before beginning to compact with a sheepsfoot roller. The inspector added that, even after the sheepsfoot compaction had proceeded for a number of feet, a vertical pipe of wet brown silty clay foundation material persisted near the center of this embankment section. This pipe was so unstable that the assistant inspector had no trouble placing his hand and arm down into it. The state inspector also charged that the contractor had placed the new embankment at the right side of the stream on top of older embankment not prepared as provided for in the specifications. As a result, on October 14, 1950, a trench was dug through the critical section of the dam breast, 20 feet wide and 200 feet long, in order to verify the condition of the placed materials. Starting at approximately Station 3+50, the trench was excavated parallel to the axis of the dam towards Station 4+35, the critical point, and then terminated at Station 5+50. Based upon the observations made, it was concluded that the contractor had complied with the specifications concerning embankment placement. A small amount of very impervious clay had worked its way up about three feet through the embankment, but had become stabilized at that height. The pocket of clay was removed. Other than this, there is no documentation of the embankment placement and quality. However, there is mention of the absence of field equipment for compaction control testing at initial stages of construction. After this incident, it appears that quality testing of the embankment fill may have been performed.

Results of the concrete cylinder test breaks during construction of the outlet structure indicated that the strengths were as low as 1,896 psi, less than the required 2,400 psi for the seven day strength. Reportedly, too much water was being added to the mix. No other records concerning concrete placement are available.

The state accepted the dam at the prefinal inspection meeting on November 28, 1950. Final General State Authority inspection of the dam was held on May 15, 1951. The final inspection disclosed a "spring" flowing from each side of the outlet channel downstream of the dam. It was remembered that springs were uncovered during the excavation for the dam in this area, and the spring flow was protected by dumped stone. The downstream slope and downstream toe of the dam were inspected, and no signs of excess water or piping

through the dam were observed. The dam was accepted as having been constructed substantially in accordance with plans and specifications. The GSA Certificate of Completion was executed on May 17, 1951.

An inspection was conducted in July 1967, by the Operations and Maintenance Branch of the Department of Forests and Waters. No seepage was noted along the downstream toe of the dam. Excessive hairline cracking was visible along the right spillway wall, and a slight scouring and undercutting was in evidence along the left downstream face of the spillway. The perimeter of the sluice gate showed appreciable leakage. Footpath damage was prominent all along the downstream embankment slope and, adjacent to the spillway embankment area, riprap was being thrown into the reservoir by children. Erosion was noted along the right bank downstream of the outlet structure. Recommendations were made to repair the damage.

The June 1969 maintenance inspection noted pronounced spalling and erosion taking place along the top and bottom of the spillway section. The right spillway retaining wall had developed a horizontal crack with pronounced crazing throughout the exposed wall. The wall presented an unsightly condition, but no recommendations for repair of the wall were made at that time. Recommendations were made to repair the concrete weir. During the winter of 1970, vandals broke the sluice gate stem.

The May 1972 maintenance inspection performed by the Division of Completed Projects, Department of Environmental Resources, indicated a wet area 30 feet below the toe of the dam approximately 250 feet to the left of the spillway. No turbidity was noted, and it was assumed that the condition was caused by local runoff. A large area, approximately 30 feet below the toe, was marshy in places and overgrown with trees and brush. The area below the toe of the dam was cleared for a distance of approximately 30 to 40 feet. The May 1973 inspection again noted the marshy area and, subsequently, a ditch was dug to drain the area. In June, slight leakage at the right side of the toe was noted in an inspection report filed by the park staff.

h. Normal Operating Procedures. Under normal conditions, all flow is discharged over the spillway. There are no minimum flow requirements downstream of this dam.

1.3 Pertinent Data.

A summary of pertinent data for Sand Spring Run Dam is presented as follows.

a.	Drainage Area (square miles)	1.6
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood (June 1972)	65
	Maximum Spillway Capacity	5,414
c.	Elevation (feet above MSL)	
	Top of Dam	
	Existing	1,506.4
	Design	1,506.5
	Spillway Crest (normal pool)	1,500.0
	Downstream Spillway Apron	1,496.1
	Outlet Works	
	Inlet Invert	1,489.0
	Outlet Invert	1,488.4
	Channel Bed	1,487.9
	Embankment Toe	1,493.9
d.	Reservoir (feet)	
	Length at Normal Pool	1,200
	Length at Maximum Pool (est)	1,400
e.	Storage (acre-feet)	
	Normal Pool	45
	Top of Dam (1,506.4)	139
f.	Reservoir Surface (acres)	
	Normal Pool	11
g.	Dam Data	
	Type	Zoned earth
	Length	775 feet
	Height	18.5 feet
	Crest Width	15 feet
	Volume	11,000 cubic yards
	Side Slopes	
	Upstream	
	Design	2.5H:1V
	Existing (above waterline)	2.5H:1V
	Downstream	
	Design	2H:1V
	Existing	2.0 to 2.9H:1V

	Cutoff	Cutoff trench under part of embankment
	Grout Curtain	None
h.	Spillway	
	Type	Concrete weir
	Elevation	1,500 feet
	Width	88 feet
i.	Outlet Works	
	Type	24 inch conduit at base of embankment
	Inlet (design)	1,489.0 feet
	Outlet	
	Design	1,487.0 feet
	Field Checked	1,488.4 feet
	Control	Sluice gate in tower located at upstream edge of crest

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Data Available. There are no original engineering data available for Sand Spring Run Dam located in the Department of Environmental Resources (DER), Bureau of Dams and Waterways Management files. Statements concerning design are located in the "Report Upon the Application of the General State Authority and the Department of Forests and Waters" to build a dam at Sand Spring Run.

b. Design Features. Design drawings of the dam containing plans, profiles and sections are presented in Appendix E. A summary of the features of the dam is included in Section 1.3.

2.2 Construction.

The construction history is presented in Section 1.2, paragraph g. Partial construction records are also located in the available files.

2.3 Operational Data.

There are no operational records maintained for this dam.

2.4 Evaluation.

a. Availability. All information presented herein was obtained from reports and correspondence located in DER files (Bureau of Dam Safety and Waterways Management) and supplemented by conversations with the park superintendent.

b. Adequacy. As the original hydrologic and hydraulic analysis was not available, the available data were not adequate to evaluate the engineering aspects of this dam.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. Observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix A, and are summarized and evaluated in the following sections. In general, the appearance of the facilities indicates that the dam and outlet structure are in good condition, the spillway is in fair condition, and the vegetation is considered to be in poor condition.

b. Dam. The vertical alignment of the dam crest was checked and the profile is shown on sheet 5B, Appendix A. Although the vertical profile is fairly even, there is some downwarping of the crest from the downstream edge to the upstream edge. The crest has a slight washboard appearance, probably resulting from points where dump trucks deposited the red shale fragments used to protect the crest. The upstream slope is generally in good condition, protected to the toe by dumped riprap over a gravel bedding. Near the right end of the dam (bathing beach) and adjacent to the spillway, riprap has been replaced as required with large stone. Riprap in a localized area near the outlet tower needs replacing. Large quantities of shale fragments are routinely deposited on the crest of the dam, as indicated by migration of these particles down over the riprap in some areas. The crest measures 15 feet wide, and the upstream slope above the water level is 2.5H:1V with one flatter measurement of 2.9H:1V.

The appearance of the downstream face of the dam ranges from fair to poor. The slope of the downstream face is uniform from the right end to about the area of the outlet. However, erosion gullies initially resulting from foot traffic are located at intervals along the downstream face. Some old gullies have been repaired.

The downstream face in the area from the outlet to the spillway is extremely uneven, apparently resulting from footpaths up the face and formerly repaired footpaths. A large area adjacent to the spillway is bare; see Photograph 8. The slope of the downstream face ranges from 2.0H:1V to 2.9H:1V. A U-shaped concrete structure connects the left end of the spillway to the left abutment; see Plate 5, Appendix E. A two foot deep gully is at the extreme left end of the downstream wall of this structure; Photograph 7. Damage to the abutment in this area is evident in 1968 inspection photographs. The concrete is stained, indicating soil to the

top of the wall at one time. Photographs taken during state inspections of the dam indicate erosion in this area is a perennial problem.

The vegetation covering the downstream face consists of grass and miscellaneous weeds, and is in poor to fair condition with numerous bare patches. Adjacent to the spillway is a large area with no vegetation, essentially caused by traffic over the downstream face. The vegetation tends to be "clumpy", permitting erosion downstream of each root mass; see Photograph 10.

A very small amount of seepage was noted exiting the embankment adjacent to the outlet structure walls and in the left bank of the outlet channel about 20 feet downstream from the structure. Standing water was noted in the marshy area about 220 feet to the right of the outlet structure and 20 feet downstream of the toe of the dam, a marshy area historically noted in this vicinity. At the time of the inspection, no discernible movement of the water was observed. The upstream end of the marshy area is at the point where brush and trees begin downstream of the dam. Water flows through a ditch before joining with the main spillway channel approximately 200 feet downstream of the toe of the embankment. The water was observed to be clear.

c. Appurtenant Structures.

1. Spillway. The right spillway gravity retaining wall displayed crazed cracking, a horizontal crack at a construction joint, leachate deposits and iron staining on its outside face. The wall appears to have been repaired, and records indicate it was painted with silicone paint in 1972. The lower portion near the downstream edge appears to bulge, possibly as a result of deflecting forms, Photographs 13 and 14, near the bottom of the wall, and no lateral displacement was observed between sections at the horizontal crack. The wall appears to be founded on bedrock and to be undermined for a depth of an inch or so, compared to a design width at that point of five feet. The crazed cracking and leachate deposits are exhibited to a significantly lesser degree on the left retaining wall.

The concrete weir and downstream apron exhibit surficial deterioration of the concrete. The appearance of the concrete indicates that it has been repaired in the past. However, there is still a large area, particularly adjacent to the left retaining wall, where the concrete has spalled off to a depth of an inch or so; see Photograph 11. Repaired horizontal cracks on the downstream face of the weir were noted, as was an unrepaired crack that was about four inches

deep and just wide enough to insert the edge of a six foot folding ruler; see Photograph 12. The depth of water over the crest was not uniform.

2. Outlet Works. The entrance to the outlet structure is underwater and could not be inspected. The exposed exterior portions and the interior of the control tower were inspected, and no significant cracking, spalling or other concrete deterioration were noted. The interior of the control tower was damp below the approximate waterline, but no actual leaks or leachate deposits were observed. The sluice gate is on the inside of the control tower, adjacent to the upstream face of the tower. Thus, the gate must resist water pressure. At the time of the inspection, the gate was leaking around its entire perimeter, and one jet of water spurted about two feet. In an attempt to reduce leakage through the gate, park personnel have installed wooden braces and a metal screw jack against the downstream wall of the control tower. Past vandalism has resulted in a bent gate stem and "popping" of gate stem guides from the wall. This vandalism is believed to have contributed to the leaking valve (according to past inspection reports). As operation of the sluice gate is a major undertaking, it was not exercised during the inspection.

The outlet conduit discharges through a concrete structure at the downstream toe. The concrete structure appeared to be in good condition, with only a slight amount of erosion at the downstream edge of the floor slab and some crazing and leachate deposits. Discharge through the pond drain flows through a channel excavated through the rock and joins the main spillway channel about 90 feet downstream of the outlet structure. The outlet channel appeared to be in good condition.

d. Reservoir. The reservoir side slopes are flat to moderate and generally wooded to the water's edge, except in the vicinity of the swimming beach. Little debris was noted at the upper end. No appreciable sediment was noted at the upstream end of the reservoir.

e. Downstream Channel. The channel immediately downstream is excavated through rock for about 130 feet downstream of the weir. Spillway discharge flows through a five foot deep stilling basin before entering a channel excavated through earth. Approximately 360 feet downstream of the weir, spillway discharge enters the original stream bed. The original stream channel varies from 10 to 20 feet wide, with low channel banks and boulders in the stream bed. The channel banks and floodplain are heavily overgrown. About 1,000 feet downstream of the dam, Sand Spring Run flows under Pennsylvania Route 534. Three downstream dams are within one mile of

Sand Spring Run Dam. The middle one, DER No. 13-54, is a masonry dam about 15 feet high and currently being repaired; see Photograph 15. The main damage center is located 1.3 miles downstream of the dam at the location of the park headquarters. The headquarters building is located about one foot above the channel banks. At that point, the channel is about six feet deep. A small church is located about 270 feet left of the stream and six feet above the channel bank in the area of the park headquarters. Other structures shown on Plate 1 downstream of the park headquarters include the park superintendent's home about 30 feet above the channel bank and a garage, closer to the top of the channel bank. About 1,000 feet below the park headquarters, Sand Spring Run enters Hickory Run. Hickory Run flows through a wooded area for about 1.7 miles downstream of the park headquarters to empty into the Lehigh River. No other inhabited structures were noted between the park headquarters and the confluence of Hickory Run with the Lehigh River. Therefore, it is assessed that a "Significant" hazard classification for this structure is warranted.

3.2 Evaluation.

Inspection of the dam and appurtenant facilities indicated that routine maintenance has been performed on the structure. The appearance of the spillway retaining walls and weir indicates they are in fair condition, the embankment is in good condition, and the vegetation is in poor condition. The problems of gullies forming over the downstream face as the result of foot traffic are inherent with an earth structure located in a public park. Damage to the downstream face could be minimized by the installation of three sets of steps up the downstream slope: one located at the downstream juncture of the left retaining wall and abutment, Photograph 7; one located in the vicinity of the junction of the right spillway retaining wall and embankment; and one set located near the right end of the dam.

Deterioration of the concrete appears to be of a limited depth. The spalled areas on the weir should be repaired, and all cracks should be sealed to prevent further damage by freezing water. The slight seepage noted in the vicinity of the outlet structure is probably exiting from the rock toe drain at that point. Seepage noted downstream of the dam at its approximate midpoint is at the vicinity of the original stream channel, a topographic low point. As no outlets to the rock toe drain are indicated on the drawings nor were any observed in the field, it is probable that the observed seepage represents the entire quantity intercepted by the rock toe and only requires monitoring for turbidity or an increase in volume.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures.

Operation of the dam does not require a dam tender. Water normally discharges over the spillway at elevation 1,500. Operating procedures include maintaining a sufficient downstream flow to maintain fish life if the reservoir level is below the spillway crest.

4.2 Maintenance of the Dam.

The Bureau of State Parks has developed an operation and maintenance manual for Sand Spring Run Dam. Park employees provide maintenance for the dam. It is noted that, although procedures were suggested for reseeding areas, no procedures were suggested for maintaining a good vegetative cover on the embankment.

4.3 Maintenance of Operating Facilities.

The operation and maintenance manual suggests lubricating the pond drain stem, as required, once every six months. The pond drain gate is exercised when it is required to draw down the reservoir to repair the swimming beach. The reservoir was last drawn down in 1978.

4.4 Warning Systems In Effect.

There are no written warning procedures in effect for Sand Spring Run Dam.

4.5 Evaluation.

It is judged that the current operating procedure, which does not require a dam tender, is a realistic means of operating the relatively simple control facilities of Sand Spring Run Dam. The written operation and maintenance manual was reviewed, and the recommendation is made that provisions be made for adequate maintenance of embankment vegetation. A warning procedure should be developed and implemented that would include surveillance of the dam during periods of high rainfall runoff.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design/Evaluation Data. The original design data for this dam that were available for review are limited to statements in the application report. Hydrologic and hydraulic calculations made as a part of this investigation are contained in Appendix D.

The watershed is small and lies completely within the state park boundaries. The oval shaped watershed is about 2.1 miles long and has a maximum width of 1.4 miles, for a total area of about 1.58 square miles. Elevations range from a high of about 1,920 in the upper reaches to 1,500 at the normal pool level. The watershed is over 90 percent wooded with no permanent residential development. Development within the watershed is limited to development of recreational facilities within the park. The runoff characteristics of the watershed are not expected to change with time.

The original design information on Sand Spring Run Dam indicates a spillway capacity of 4,900 cfs, based on an 88 foot long weir and a coefficient of discharge equal to 3.8.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Small" size dam and "Significant" hazard classification is the 100 Year Flood to one-half the Probable Maximum Flood (PMF). Based on the limited total capacity of the reservoir and limited downstream development, the 100 Year Flood could be an acceptable spillway design flood. However, based on the capacity of the spillway, it was decided to use one-half the PMF as the spillway design flood.

b. Experience Data. No reservoir level records are maintained for this dam. The only estimate of available previous high reservoir levels is a maximum depth of four inches over the weir during Tropical Storm Agnes, June 1972. It is noted that Sand Spring Run Dam does not lie in the path of the maximum rainfall for that event. The reported maximum 24 hour rainfall at the closest National Weather Service recording station was 2.89 inches.

c. Visual Observations. On the date of the inspection, there were no conditions observed that would indicate a reduced spillway capacity in the event of a large storm. Other observations regarding the condition of the downstream

channel, spillway and reservoir are presented in Appendix A and discussed in greater detail in Section 3.

d. Overtopping Potential. The overtopping potential of this dam was estimated using the "HEC-1, Dam Safety Version" computer program. A brief description of the program is included in Appendix D. Calculations for this investigation estimate the maximum spillway capacity to be about 5,414 cfs when the reservoir level is at the minimum crest elevation. The HEC-1 computed peak one-half PMF inflow is 1,388. Calculations presented in Appendix D indicate that the spillway is capable of discharging the full PMF (2,776 cfs) without overtopping the dam.

e. Spillway Adequacy. As the spillway is capable of discharging the spillway design flood, one-half the PMF, without overtopping the embankment, the spillway is considered to have an "Adequate" classification.

f. Downstream Conditions. About 1,000 feet downstream of the dam, Sand Spring Run flows under Pennsylvania Route 534 to a pond formed by a low masonry dam. About 1,400 feet farther downstream is a 15 foot high masonry dam, Photograph 15, which is currently being repaired. About 2,000 feet farther downstream is a six foot high dam. The reservoir surface area is less than one-half acre and the reported (DER Water Resources Bulletin No. 5) capacity is less than one acre-foot for each of the three dams. Thus, failure of any or all of the three dams could be expected to have little effect at the downstream damage center, the park headquarters. Sand Spring Run is about 25 feet wide and six feet deep at the park headquarters, and the building is about one foot above the channel bank. Although the headquarters is occupied during the day, the park superintendent does not live in the building, and loss of life is not envisioned. A "Significant" hazard potential is justified for Sand Spring Run Dam.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Evidence of potential instability of the embankment detected by visual observations is limited to the surficial damage resulting from foot traffic and erosion over the downstream face. The downstream face is uniform, except the area between the spillway and outlet structure, where foot traffic, erosion and repair of gullies have caused material to move downslope, flattening the slopes. The vegetation is in poor condition, permitting some erosion not associated with foot traffic, as shown on Photograph 10. The crest is protected by shale fragments and is not damaged by foot or vehicle traffic. The upstream face and riprap are in good condition.

The spillway and retaining walls are judged to be in fair condition. The observed concrete deterioration of the weir appears to be surficial. The observed deterioration of the downstream right spillway retaining wall appears not to have affected its structural integrity. The left spillway retaining wall appears to be in fairly good condition.

b. Design and Construction Data. Design data that are available include logs of test pits and borings, flow measurements in Sand Spring Run, and topographic and design drawings of the dam. There are no data documenting design analyses for the dam in the file. Construction data include memoranda regarding bidding and contracting, invoices, and scheduling. Additional memoranda address events of the construction and contain sparse test data documenting the quality of construction, design changes and vendors' drawings. All data concerning the present condition of the dam were obtained from design drawings, construction memoranda, inspection reports and visual observations.

c. Operating Records. An "Operation and Maintenance Manual for Sand Spring Run Dam, Hickory Run State Park", dated February 1979, has been developed for this dam.

d. Post-Construction Changes. There are no records nor is there any evidence that any major modifications were made to this dam.

e. Embankment Stability. There were no embankment stability evaluations located in the files. Based on the visual observation, the dam appears to be stable provided overtopping does not occur and erosion on the downstream face is controlled.

f. Seismic Stability. The dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone is stable under static conditions, it can be assumed safe for any expected earthquake conditions. Since the dam is qualitatively assessed to be stable under static loading conditions at the present time, it can also reasonably be considered to be stable under seismic loading conditions.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Evaluation. Visual inspection and review of the available design and construction documentation indicate that the embankment and outlet structures of Sand Spring Run Dam are in good condition, the concrete weir is in fair condition, and the vegetation is in poor condition. The overall assessment is considered fairly good at the present time.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Small" size dam and "Significant" hazard potential classification is the 100 Year Flood to one-half the Probable Maximum Flood (PMF). As the dam's total capacity is nearer the lower limit of the size classification and because of the limited number of occupied structures downstream, the 100 Year Event would be an adequate spillway design flood. However, one-half the PMF has been used in this case because of the actual spillway capacity. Hydrologic and hydraulic computations presented in Appendix D indicate the spillway is capable of passing the full PMF without overtopping the embankment, resulting in an "Adequate" spillway classification for this dam.

b. Adequacy of Information. The combined visual inspection, review of available data and simplified calculations presented in Appendix D were sufficient to determine that no further investigations are required for this structure.

c. Urgency. It is recommended that the measures presented in the following section be implemented as specified.

7.2 Remedial Measures.

a. Facilities. It is recommended that the following measures be undertaken as soon as practical.

(1) The deteriorated surficial concrete of the weir should be repaired. All open cracks in the concrete should be sealed to prevent damage from freezing water.

(2) Damage to the downstream face of the embankment resulting from foot traffic and erosion should be repaired.

(3) In conjunction with (2), consideration should be given to the installation of three sets of steps up the downstream slope to reduce future damage to the embankment.

(4) Seepage existing adjacent to the outlet structure and downstream of the dam should be monitored for turbidity or an increase in volume.

b. Operation and Maintenance Procedures. The operation and maintenance manual was reviewed, and it is recommended that procedures concerning vegetation be expanded to include recommendations for maintaining a good stand of vegetation. It is also important to note that people responsible for operation and maintenance of the dam be familiar with the manual. Because of the location of the dam above the park headquarters with the potential for property damage and few or no lives lost in the event of high flows or failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented for this facility.

APPENDIX

A

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam *Sand Spring* County *Carbon* State *Pennsylvania* National ID # *PA 00614*

Type of Dam *Earth* Hazard Category *Significant*

Date(s) Inspection *6/12/80* Weather *Sunny* Temperature *60's*

Pool Elevation at Time of Inspection *1500+* M.S.L. Tailwater at Time of Inspection *1484.9* M.S.L.
level in stilling basin about 70 feet downstream of weir.

Inspection Personnel:

Mary F. Beck (Hydrologist) *Vincent McKeever (Hydrologist)*

Raymond S. Lambert (Geologist) *John Frederick, (Geotechnical)* *(5/15/1980)*

Richard E. Mabry (Geotechnical)

Mary F. Beck Recorder

Remarks:

Mr. Robert Kern, Park Superintendant, was on site and provided assistance to the inspection team.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	*N/A*	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	*N/A*	
DRAINS	*N/A*	
WATER PASSAGES	*N/A*	
FOUNDATION	*N/A*	

Sheet 2 of 11

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	*N/A*	
STRUCTURAL CRACKING	*N/A*	
VERTICAL AND HORIZONTAL ALIGNMENT	*N/A*	
MONOLITH JOINTS	*N/A*	
CONSTRUCTION JOINTS	*N/A*	

Sheet 3 of 11

EMBANKMENT

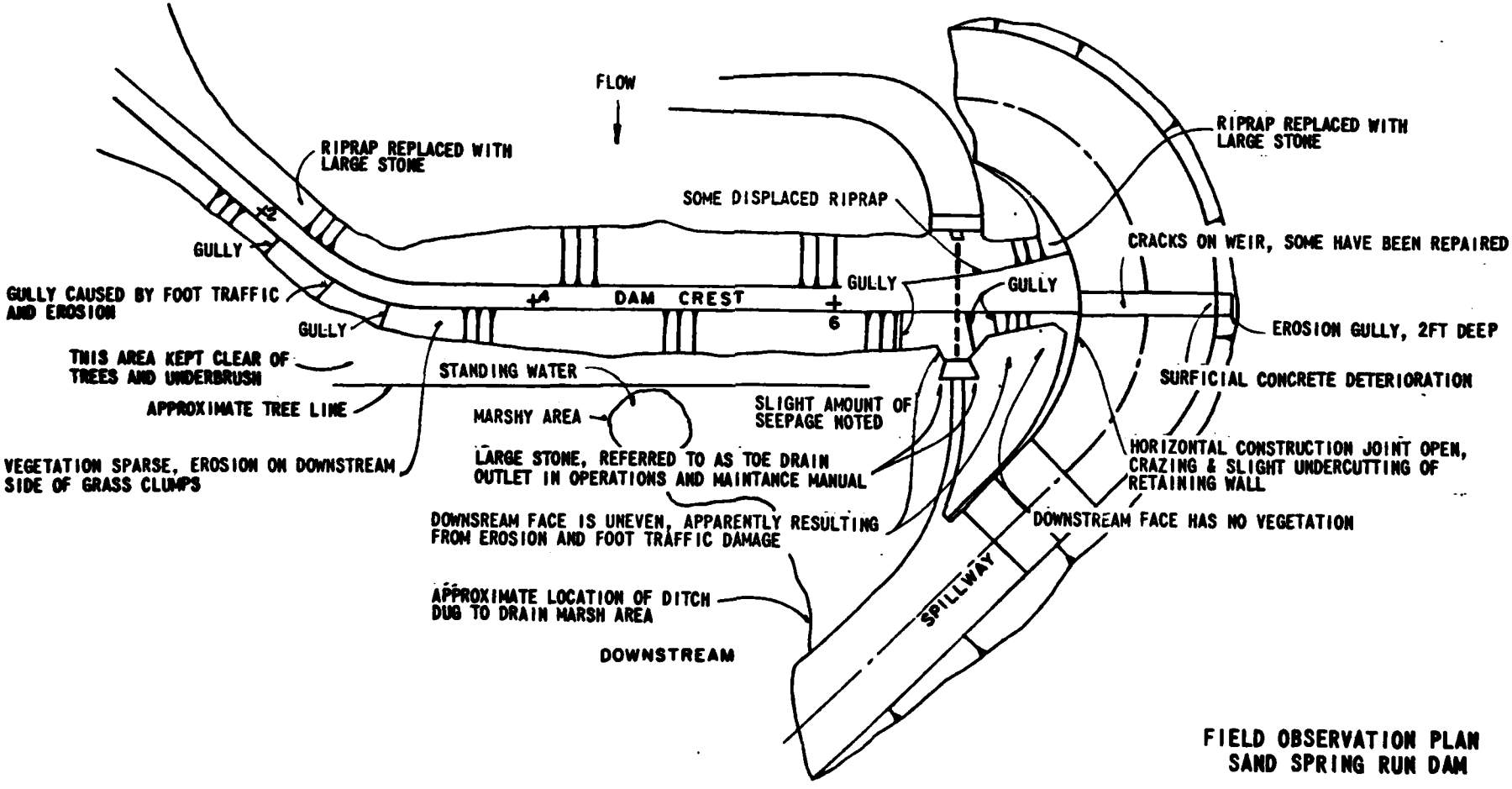
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	*None observed.*	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	*None observed*	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	*Erosion on downstream face has resulted from foot traffic and poor vegetation cover. Gullys have formed over downstream edge of crest as a result of foot traffic.*	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	*See Sheet 5B of 11. The crest has a "washboard" appearance, apparently from dumping of gravel size shale on crest. Crest appears to have a downslope towards the upstream edge.*	
RIPRAP FAILURES	*Riprap is being displaced by vandals and has been partially replaced with derrick stone near the swimming beach and spillway.*	

Sheet 4 of 11

EMBANKMENT

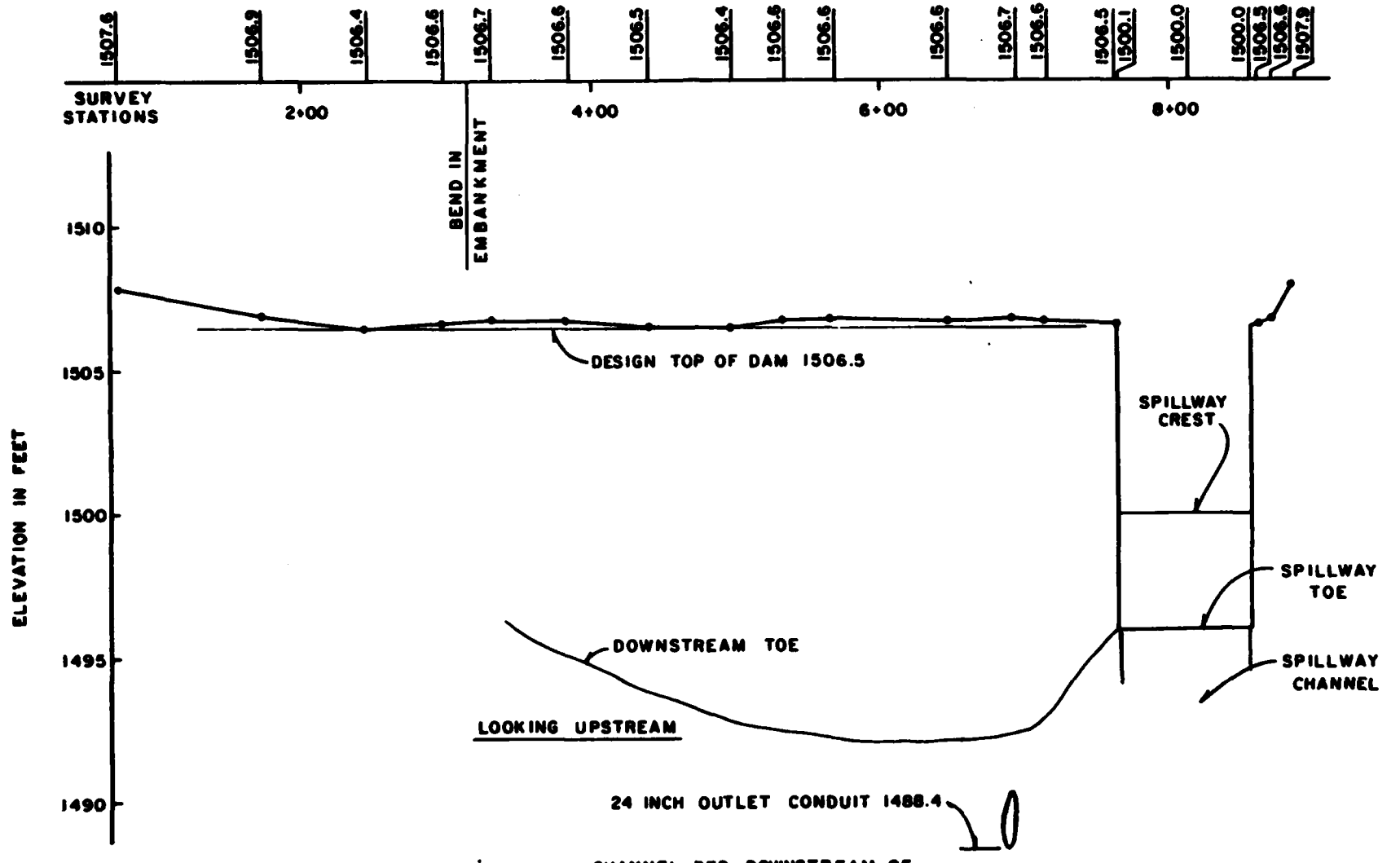
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	*Appears in poor condition with small bare patches and "hummocky" appearance. Miscellaneous growth of grass, weeds and vine type. Erosion is taking place on the downslope side of grass clumps.*	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*All upstream junctions are in good condition. The right downstream junction between embankment and abutment is a gentle transition between dam crest width and original ground and is in good condition. The downstream junction between the embankment and spillway and at the left abutment have been damaged by foot traffic and erosion.*	
ANY NOTICEABLE SEEPAGE	*Slight seepage noted adjacent to outlet wing walls above the invert elevation. Standing water is about 20 feet downstream of the toe, Sheet 5A of 11, forming a marshy area. Seepage drains toward the spillway channel, entering about 250-300 feet downstream of the dam. Seepage could be from rock toe, see drawings, Appendix E.*	
STAFF GAGE AND RECORDER	*None*	
DRAINS	*No outlets from the rock toe drain are noted on the plans or located in the field. The Operations and Maintenance manual indicates the rock toe outlets at the outlet structure.*	

Sheet 5 of 11



FIELD OBSERVATION PLAN
SAND SPRING RUN DAM

SHEET 5A OF 11



FIELD OBSERVATION PROFILE
SAND SPRING DAM

SHEET 5B OF 11

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*Conduit through embankment was not inspected.*	
INTAKE STRUCTURE	*The exposed exterior and interior of the control tower was inspected and no significant cracking, spalling or other concrete deterioration noted. Inside of tower was damp below waterline. Holes are in the upstream wall where gate stem supports had been anchored into concrete.*	
OUTLET STRUCTURE	*The exposed portions of the outlet structure appear in good condition with only minor concrete erosion at downstream edge, see Photograph No. 3.*	
OUTLET CHANNEL	*Outlet channel, excavated through bedrock to join spillway channel about 90 feet downstream, is in good condition.*	
EMERGENCY GATE	*Sluice gate on inside of intake tower does not seat completely and water leaks around perimeter. Wood braces and metal jack are used in an attempt to seal the gate.*	

Sheet 6 of 11

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	*Appears in good condition with surficial spalling of concrete. Repaired sections also spalling off. Leachate deposits on face of wing wall. Some concrete erosion below waterline on right wing wall.*	
APPROACH CHANNEL	*Below the water level.*	
DISCHARGE CHANNEL	*Channel excavated through bedrock for about 120 feet.*	
BRIDGE AND PIERS	*None*	
RETAINING WALLS	*The right gravity retaining wall displays crazed cracking, two repaired horizontal cracks, leachate deposits and iron staining on its outside face. The same conditions are evident to a much less degree on the left retaining wall.*	

Sheet 7 of 11

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	*N/A*	
APPROACH CHANNEL	*N/A*	
DISCHARGE CHANNEL	*N/A*	
BRIDGE AND PIERS	*N/A*	
GATES AND OPERATION EQUIPMENT	*N/A*	

Sheet 8 of 11

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	*None*	
OBSERVATION WELLS	*None*	
WEIRS	*None*	
PIEZOMETERS	*None*	
OTHER	*None*	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*Reservoir side slopes are flat to moderate and wooded to water's edge except for swimming beach. Little small debris noted at upper end.*	
SEDIMENTATION	*No noticeable sediment at upstream end of reservoir.*	

Sheet 10 of 11

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*The spillway channel discharges into the natural stream about 360 feet downstream of the weir. The stream channel is 10 to 20 feet wide with boulders on the stream bed. The banks and floodplain are heavily overgrown with rhododendron.*	
SLOPES	*The valley gradient is about 0.02.*	
APPROXIMATE NO. OF HOMES AND POPULATION	*The first major damage center is about 1.3 miles downstream at the park headquarters. The building is about one foot above the channel bank. A church (about 270 feet left of the stream) is about 6 feet above the channel bank.*	

Sheet 11 of 11

APPENDIX

B

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *Sand Spring Run Dam*

ID # *PA 00614*

ITEM	REMARKS
AS-BUILT DRAWINGS	*None available.*
REGIONAL VICINITY MAP	*Plate 1, Appendix E.*
CONSTRUCTION HISTORY	*See text, Section 1.2*
TYPICAL SECTIONS OF DAM	*See Appendix E.*
OUTLETS - PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	*Appendix E.*
RAINFALL/RESERVOIR RECORDS	*None*

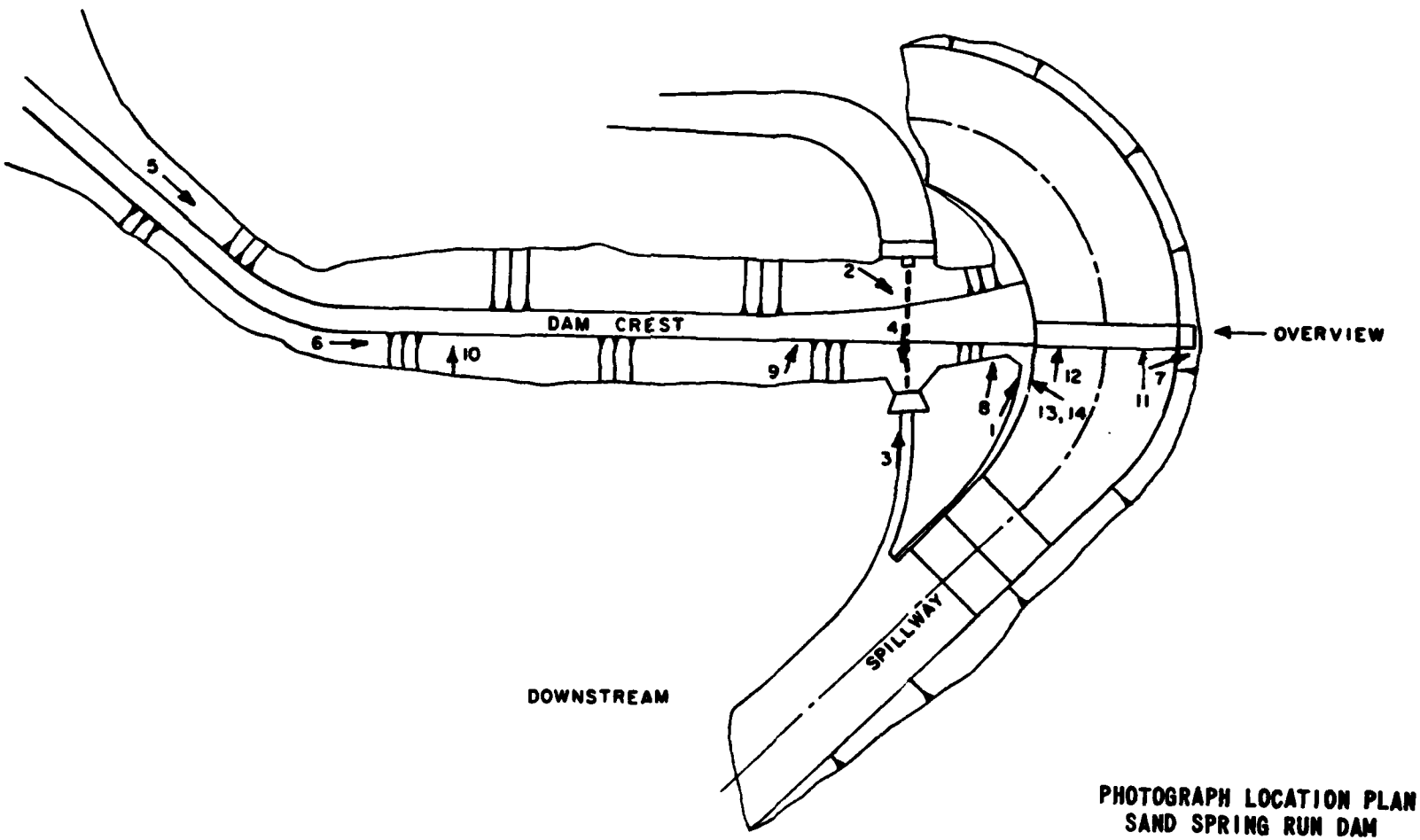
ITEM	REMARKS
DESIGN REPORTS	*None available.*
GEOLOGY REPORTS	*See Appendix F.*
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	*None available.*
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	*Data available in DER, Bureau of Dams and Waterways Management, files*
POST-CONSTRUCTION SURVEYS OF DAM	*None known.*
BORROW SOURCES	*Spillway excavation and borrow area 0.5 mile west of dam.*

ITEM	REMARKS
MONITORING SYSTEMS	*None*
MODIFICATIONS	*None*
HIGH POOL RECORDS	*None except in memo files indicating 4 inches of water over the spillway during Tropical Storm Agnes, June 1972.*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*None except routine inspection reports.*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*None*
MAINTENANCE OPERATION RECORDS	*None*

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	*See Plates, Appendix E.*
OPERATING EQUIPMENT PLANS & DETAILS	*Drawings prepared by Chapman Valve Manufacturing Company for 24 inch sluice gate are in DER, Bureau of Dams and Waterways Management, files.*
MISCELLANEOUS	*The following information was available in DER, Bureau of Dams and Waterways Management, files.* 1. *Five sheet set of design drawings.* 2. *"Report Upon the Application" prepared by DER, dated July 11, 1950* 3. *"Permit to Construct a Dam", issued by DER, July 12, 1950* 4. *Results of laboratory testing of embankment soils.* 5. *Results of construction documentation testings for embankment and structures.* 6. *Correspondence and memorandums during design and construction period.* 7. *Inspection reports subsequent to construction.* 8. *54 black and white photographs taken during construction and 72 black and white photographs taken during inspections.*

APPENDIX

C

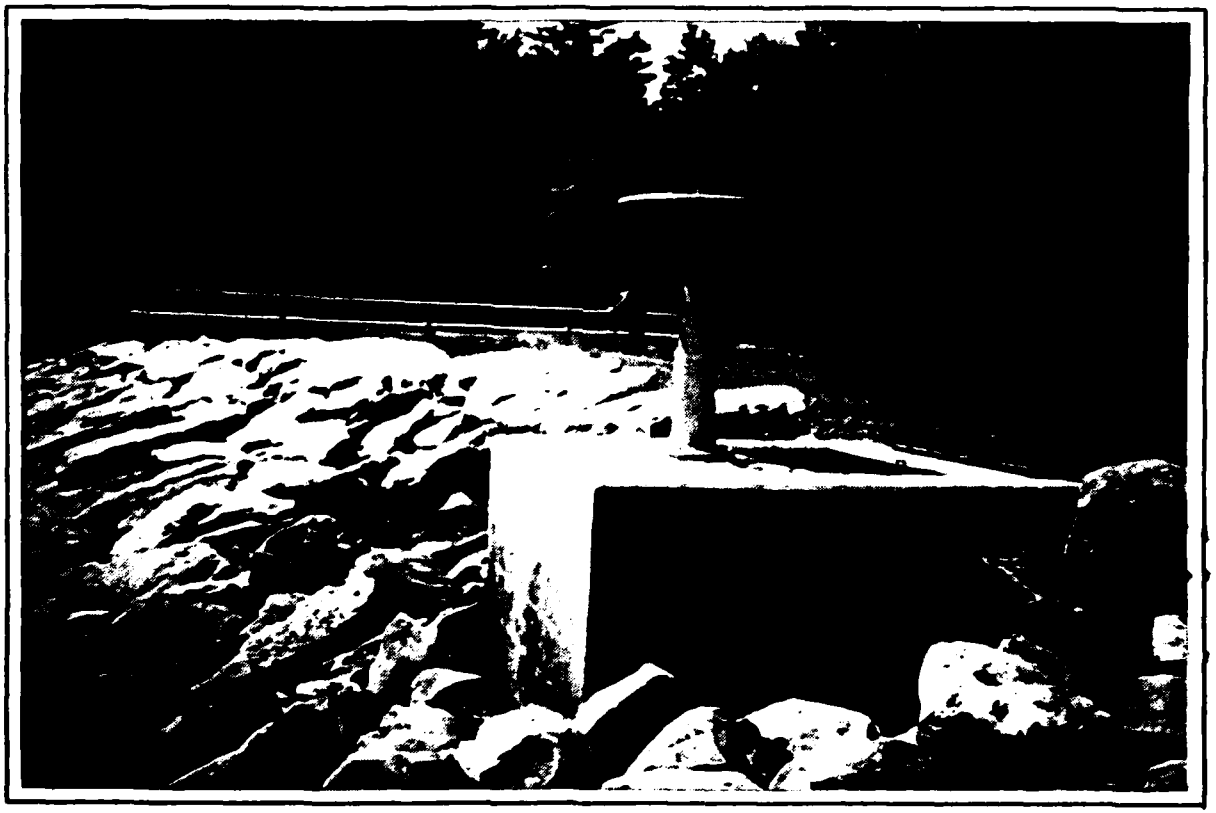


PHOTOGRAPH LOCATION PLAN
SAND SPRING RUN DAM

PLATE C-1

VIEW OF SPILLWAY AND DISCHARGE CHANNEL
EXCAVATED THROUGH ROCK.

PHOTOGRAPH NO. 1

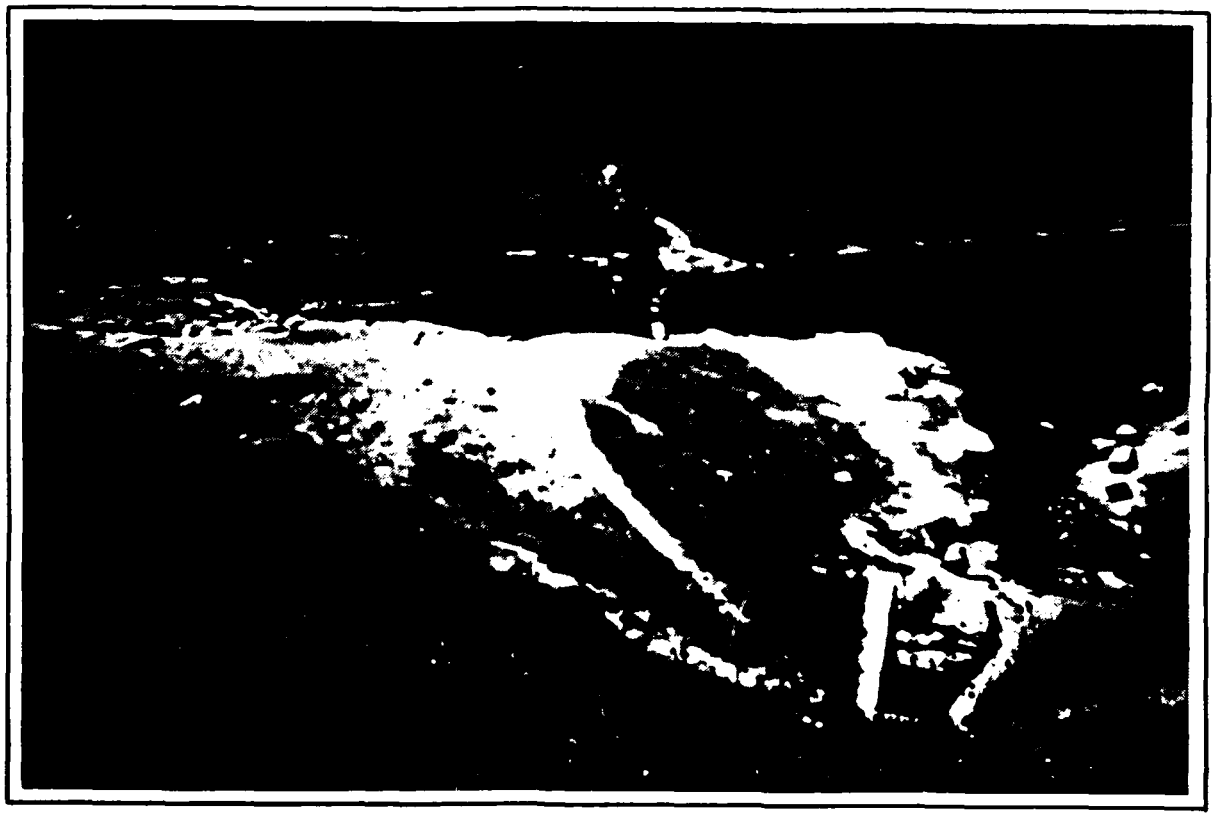


SLUICE GATE HOIST AND CONTROL TOWER LOCATED AT THE UPSTREAM EDGE OF THE CREST.

PHOTOGRAPH NO. 2

POND DRAIN OUTLET STRUCTURE AND DISCHARGE CHANNEL EXCAVATED THROUGH ROCK.

PHOTOGRAPH NO. 3



OVERALL VIEW OF POND DRAIN DISCHARGE CHANNEL AND SPILLWAY CHANNEL DOWNSTREAM OF DAM.

PHOTOGRAPH NO. 4

UPSTREAM FACE NEAR THE RIGHT END OF THE DAM AND BATHING BEACH. DERRICK STONE IS USED TO REPAIR RIPRAP.

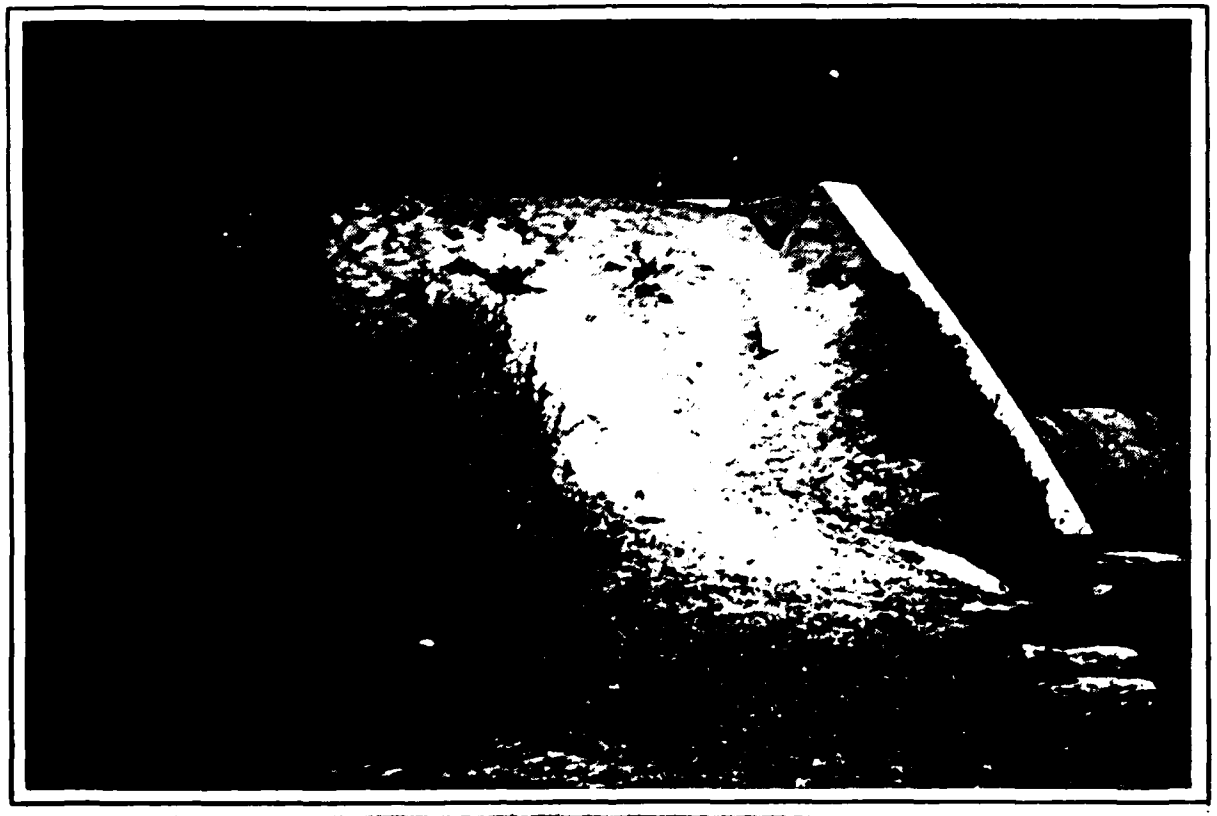
PHOTOGRAPH NO. 5

VIEW OF CREST AND DOWNSTREAM FACE NEAR
BEND IN EMBANKMENT.

PHOTOGRAPH NO. 6

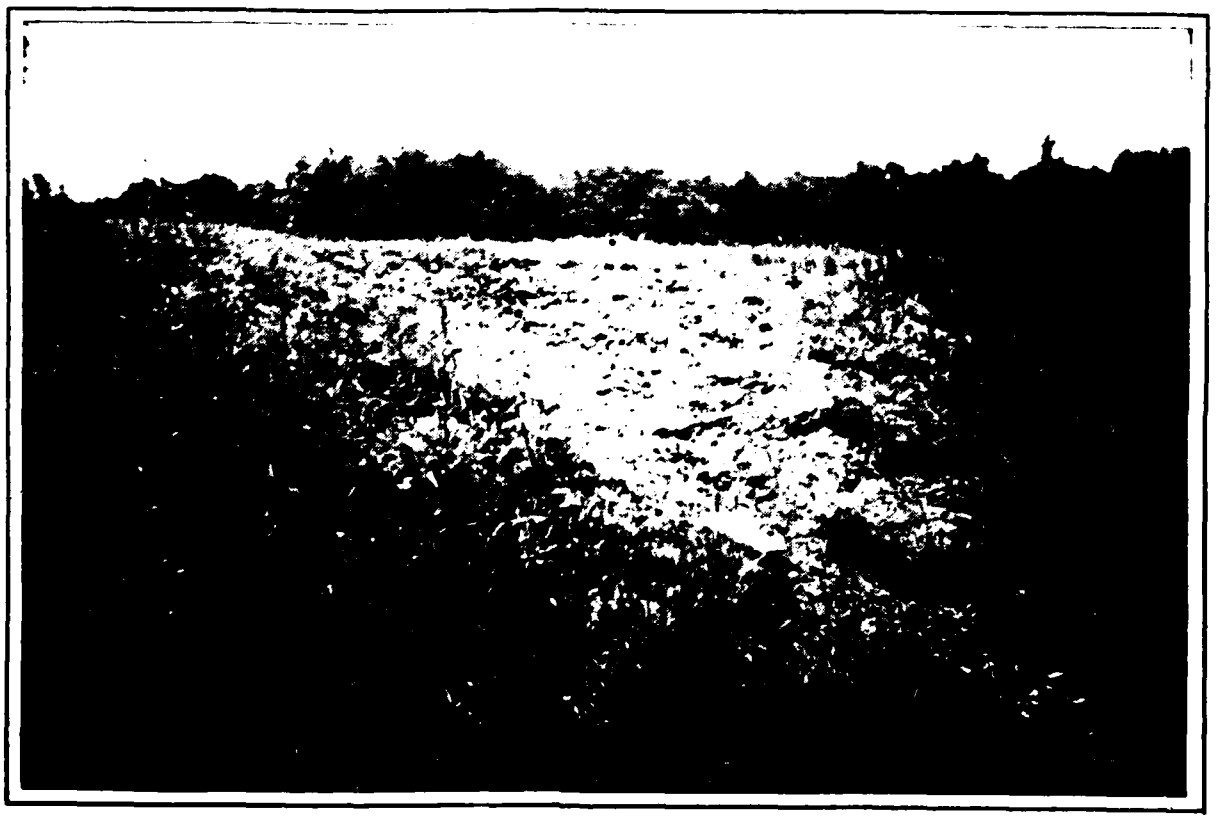
FOOT TRAFFIC AND EROSION DAMAGE AT THE DOWNSTREAM JUNCTION OF THE LEFT ABUTMENT AND SPILLWAY RETAINING WALL.

PHOTOGRAPH NO. 7



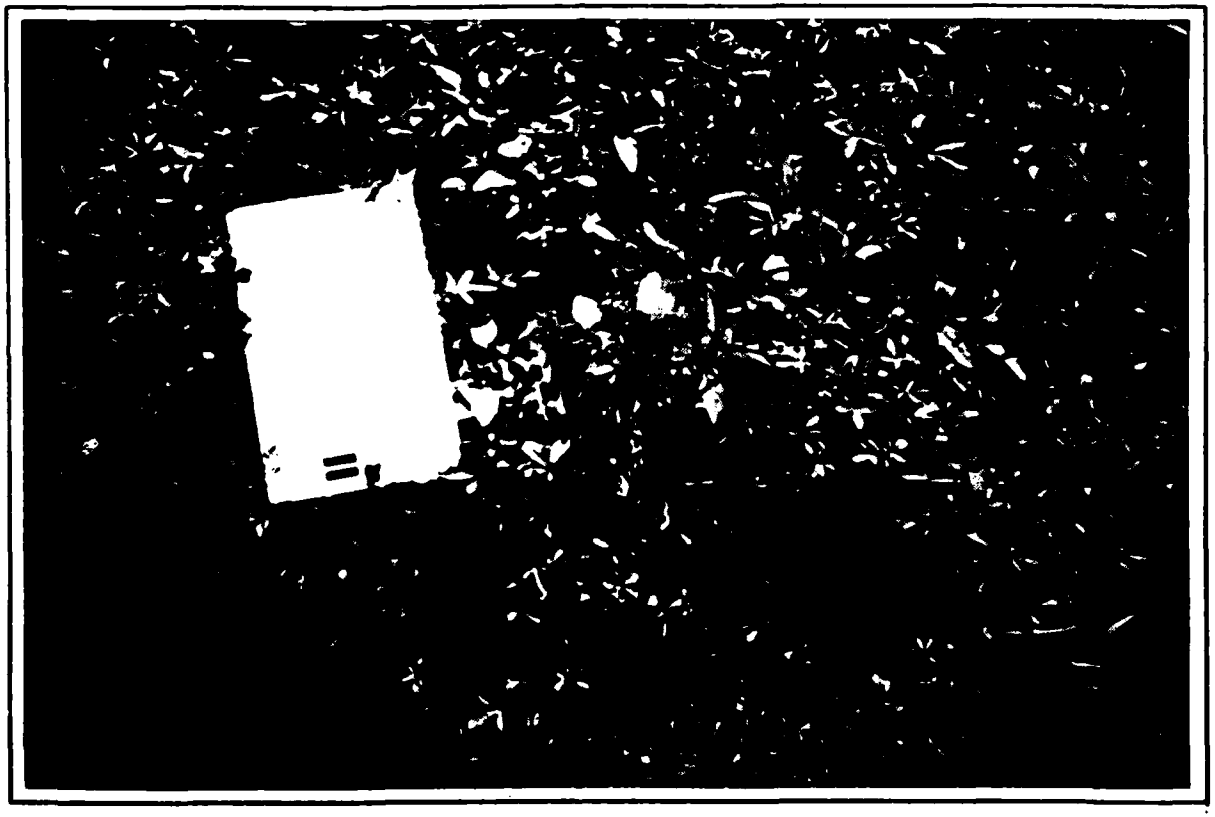
FOOT TRAFFIC AND EROSION DAMAGE TO THE DOWNSTREAM SLOPE ADJACENT TO RIGHT SPILLWAY RETAINING WALL.

PHOTOGRAPH NO. 8



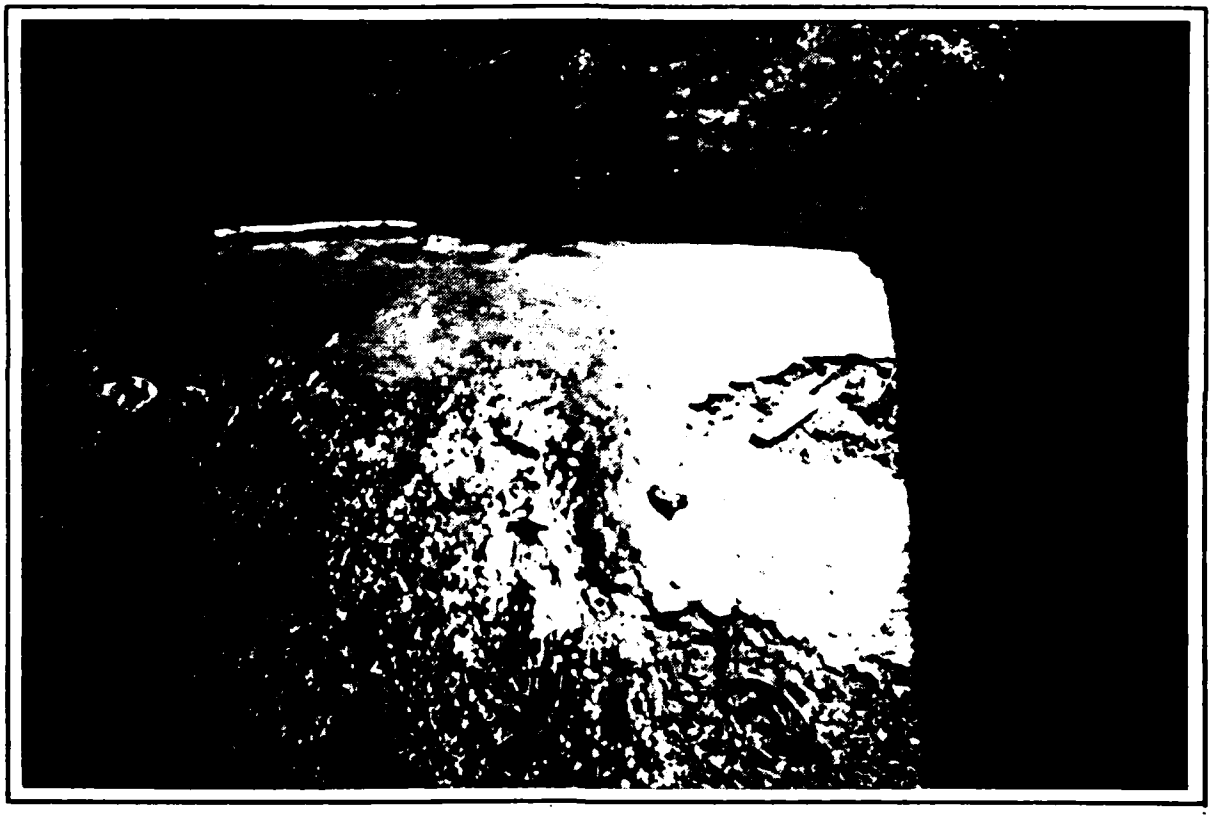
TYPICAL GULLEY OVER DOWNSTREAM EDGE
OF CREST.

PHOTOGRAPH NO. 9



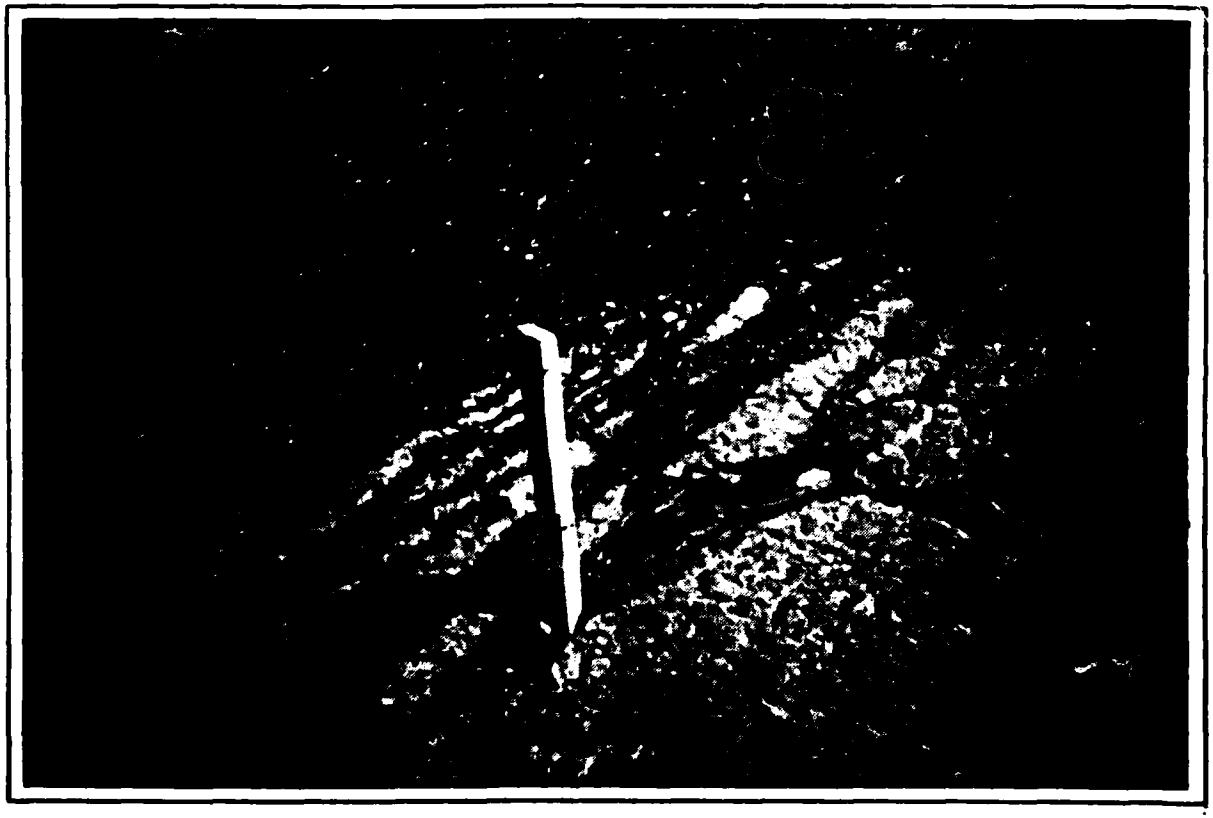
SPARSE VEGETATION NEAR RIGHT END OF DAM.

PHOTOGRAPH NO. 10



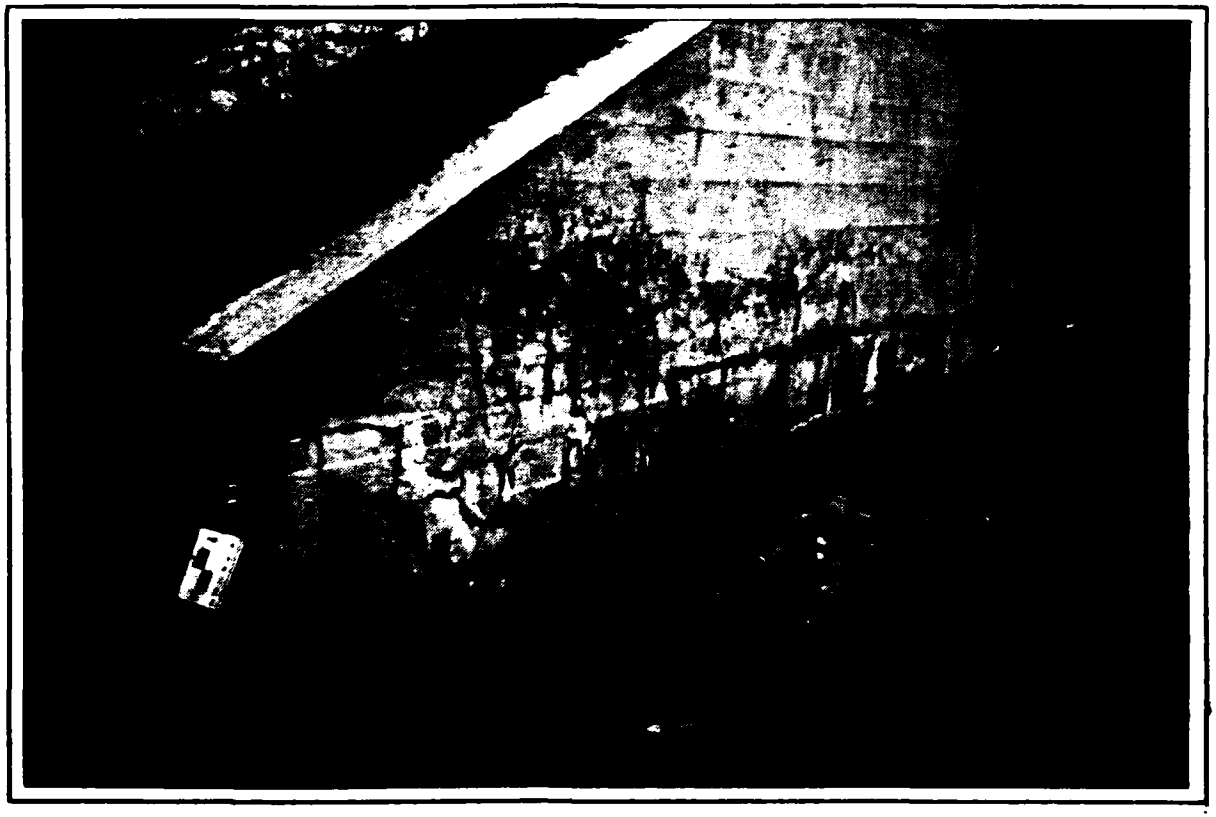
TYPICAL SPALLED AREA ON WEIR.

PHOTOGRAPH NO. 11



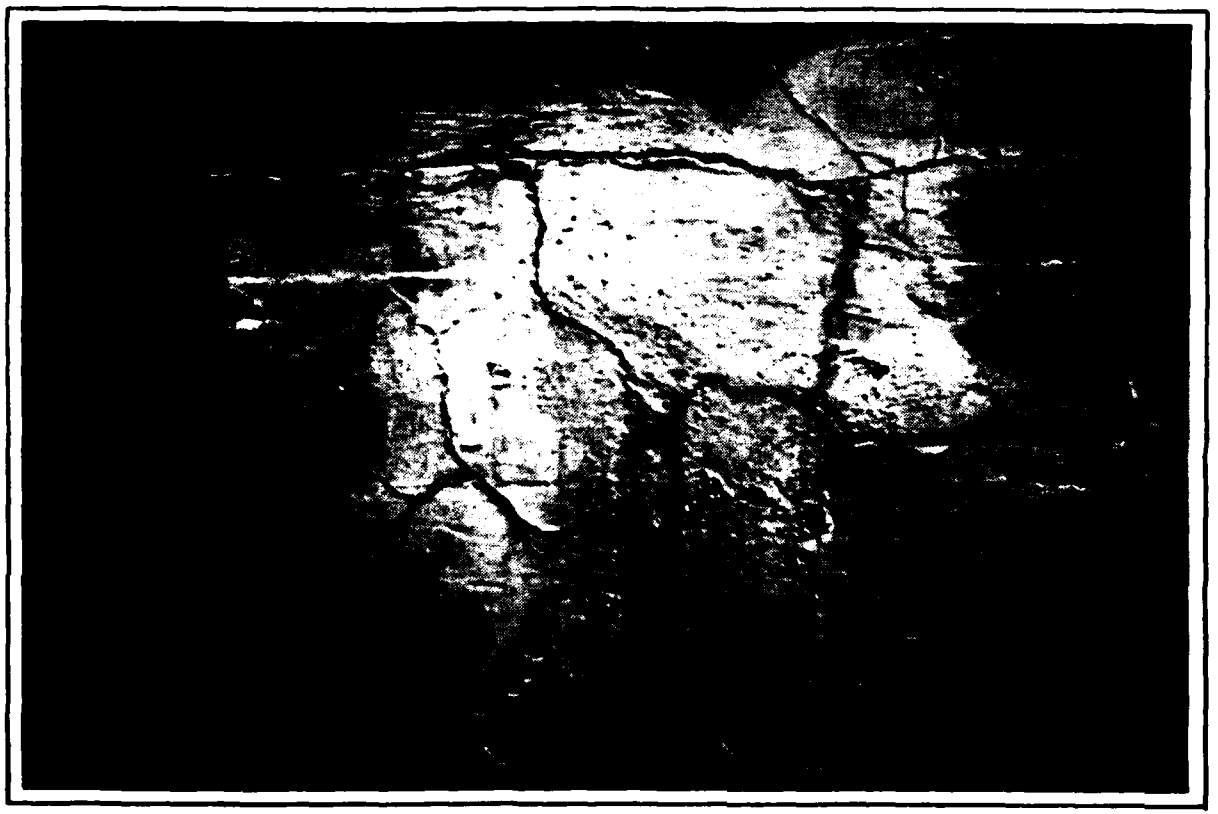
CRACKING ON DOWNSTREAM FACE OF WEIR.

PHOTOGRAPH NO. 12



RIGHT SPILLWAY RETAINING WALL.

PHOTOGRAPH NO. 13



CLOSE-UP OF WALL SHOWN IN PHOTOGRAPH NO. 13.

PHOTOGRAPH NO. 14

DOWNSTREAM 15 FOOT HIGH DAM, CURRENTLY BEING REPAIRED.

PHOTOGRAPH NO. 15

THE PARK HEADQUARTERS IS LOCATED BEHIND THE TREES IN THE UPPER LEFT PORTION OF THE PICTURE.

PHOTOGRAPH NO. 16

APPENDIX

D

SAND SPRING RUN DAM

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *Wooded, no permanent residential development.*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *1500.0 feet (45 Acre-Feet).*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *1506.4 feet (139 Acre-Feet).*

ELEVATION MAXIMUM DESIGN POOL: ----

ELEVATION TOP DAM: *1506.5 feet design, 1506.4 feet existing.*

SPILLWAY

a. Elevation *1500.0 feet.*

b. Type *Concrete weir.*

c. Width *88 feet*

d. Length --

e. Location Spillover *Left abutment.*

f. Number and Type of Gates *None*

OUTLET WORKS:

a. Type *24 inch conduit at base of embankment, control tower at upstream edge of crest.*

b. Location *75 feet right of spillway.*

c. Entrance inverts *1489.0 feet.*

d. Exit inverts *1487.0 feet design, 1488.4 feet, existing.*

e. Emergency draindown facilities *Through outlet works.*

HYDROMETEOROLOGICAL GAGES:

a. Type *None within watershed.*

b. Location *N/A*

c. Records *N/A*

MAXIMUM NON-DAMAGING DISCHARGE: *Not determined.*

DRAINAGE AREA:(1) *1.58 square miles*

PROBABLE MAXIMUM PRECIPITATION (PMP)
FOR 200 SQ. MILES IN 24 HOURS:(2) *22.5 inches.*

ADJUSTMENT FACTORS FOR DRAINAGE AREA (%):(3)

Zone *1*

6 Hours *111*

12 Hours *124*

24 Hours *134*

48 Hours *142*

SNYDER HYDROGRAPH PARAMETERS:(4)

Zone *2*

C_p, C_t *0.45; 2.1*

L(5) *2.01 miles*

Lca (6) *0.99 mile*

$tp = C_t (L \cdot Lca)^{0.3}$ *2.58*

SPILLWAY CAPACITY AT MAXIMUM
WATER LEVEL(7) *5,414 cfs*

---

(1) Measured from USGS maps.
(2) Hydrometerological Report No. 33, Figure 1.
(3) Hydrometerological Report No. 33, Figure 2.
(4) Information received from Corps of Engineers, Baltimore District.
(5) Length of longest water course from outlet to basin divide, measured from USGS maps.
(6) Length of water course from outlet to point opposite the centroid of drainage area, (see Plate 1, Appendix E) measured from USGS maps.
(7) See Sheet 9 of this Appendix.

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed.

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out tables.

BY MEB DATE 2/8/80 SUBJECT Sand Spring Run Dam Hydrology / Hydraulics SHEET 4 OF 9

CHKD. BY DATE JOB No.

Classification (Ref. Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is "Significant" as there would be appreciable economic loss but with few or no lives lost in the event of failure.

2. The size classification is "Small" based on its 18.5 feet height and 139 Ac-Ft total storage capacity.

3. The spillway design flood, based on size and hazard classification, is the 100 yr. to ½ PMF. Although the 100 yr event would be an adequate spillway design flood, the ½ PMF has been selected because of the large spillway capacity.

Hydrology and Hydraulic Analysis

1. Original Data - There is no original design data available for this dam beyond statements in the "Application Report".

C = 3.8
L = 88 ft.
Q = 4900 cfs
Area = 1.9 sq. miles
} from "Application Report"

H = 6.5 ft. from design drawings

$Q = C L H^{3/2}$

$= 3.8 \cdot 88 \cdot 6.5^{3/2}$

$= 5540$ cfs > 4900 cfs

2. Evaluation Data

Inflow hydrograph parameters are shown on sh. 2. The drainage area was measured to be 1.58 square miles instead of 1.9 reported.

Outflow hydrograph

Elevation - Storage data, shown on sheet areas were measured from topo sheet in files and found to differ slightly from information on Plate Appendix E.

BY MEB DATE 2/8/80 SUBJECT Sand Spring Run Dam Hydrology / Hydraulics SHEET 5 OF 9

CHKD. BY DATE JOB No

Elevation	Surface Area	
1489	0	tape sheet
1495	4.19 Ac	
1500	11.00 Ac	
1505	16.89 Ac	
1520	34.89 Ac	USGS map

Discharge Data

$Q = CLH^{3/2}$ (calculated by computer)

$C = 3.8$ ref Table 5-13, King & Brater Handbook of Hydraulics, 2nd ed.

$L = 88$ ft. field checked

3 Spillway Adequacy - as the spillway can discharge the PMF without overtopping the embankment, the spillway classification is "Adequate".

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 80/07/08.
TIME= 11.16.36.

SAND SPRING RUN DAM
NAT ID NO. PA 00614 DER NO. 13-90
OVERTOPPING ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
200	0	15	0	0	0	0	0	-4	0

JOPER	NUT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= .50 .60 .70 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
IN	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.58	0.00	1.58	0.00	0.000	0	1	0

SHEET 6 OF 9

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.50	111.00	124.00	134.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 2.58 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 92 END-OF-PERIOD ORDINATES, LAG= 2.60 HOURS, CP= .45 VOL= 1.00

5.	18.	37.	59.	84.	110.	135.	155.	170.	180.
182.	175.	165.	155.	146.	137.	129.	121.	114.	107.
101.	95.	89.	84.	79.	74.	70.	66.	62.	58.
55.	51.	48.	45.	43.	40.	38.	36.	33.	31.
30.	28.	26.	25.	23.	22.	20.	19.	18.	17.
16.	15.	14.	13.	13.	12.	11.	10.	10.	9.
9.	8.	8.	7.	7.	6.	6.	6.	5.	5.
5.	4.	4.	4.	4.	3.	3.	3.	3.	3.
3.	2.	2.	2.	2.	2.	2.	2.	2.	1.
1.	1.								

0 END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.56	23.18	2.38	84675.
										(649.)	(589.)	(60.)	(2397.73)

SHEET 7 of 9

HYDROGRAPH ROUTING

OUTFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUT	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1500.	0

SURFACE AREA=	0.	4.	11.	17.	35.
CAPACITY=	0.	8.	45.	114.	494.
ELEVATION=	1489.	1495.	1500.	1505.	1520.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1500.0	88.0	3.8	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1506.4	0.0	0.0	0.

CREST LENGTH AT OR BELOW ELEVATION	0.	130.	570.	720.
	1506.4	1506.5	1506.7	1507.1

PEAK OUTFLOW IS 1381. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 1657. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 1934. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 2765. AT TIME 42.50 HOURS

SHEET 8 of 9

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .60	RATIO 3 .70	RATIO 4 1.00
HYDROGRAPH AT	IN	1.58	1	1388.	1666.	1943.	2776.
	(	4.09)	(	39.30)(	47.16)(	55.03)(	78.61)(
ROUTED TO	OUT	1.58	1	1381.	1657.	1934.	2765.
	(	4.09)	(	39.09)(	46.93)(	54.78)(	78.30)(

1 SUMMARY OF DAM SAFETY ANALYSIS

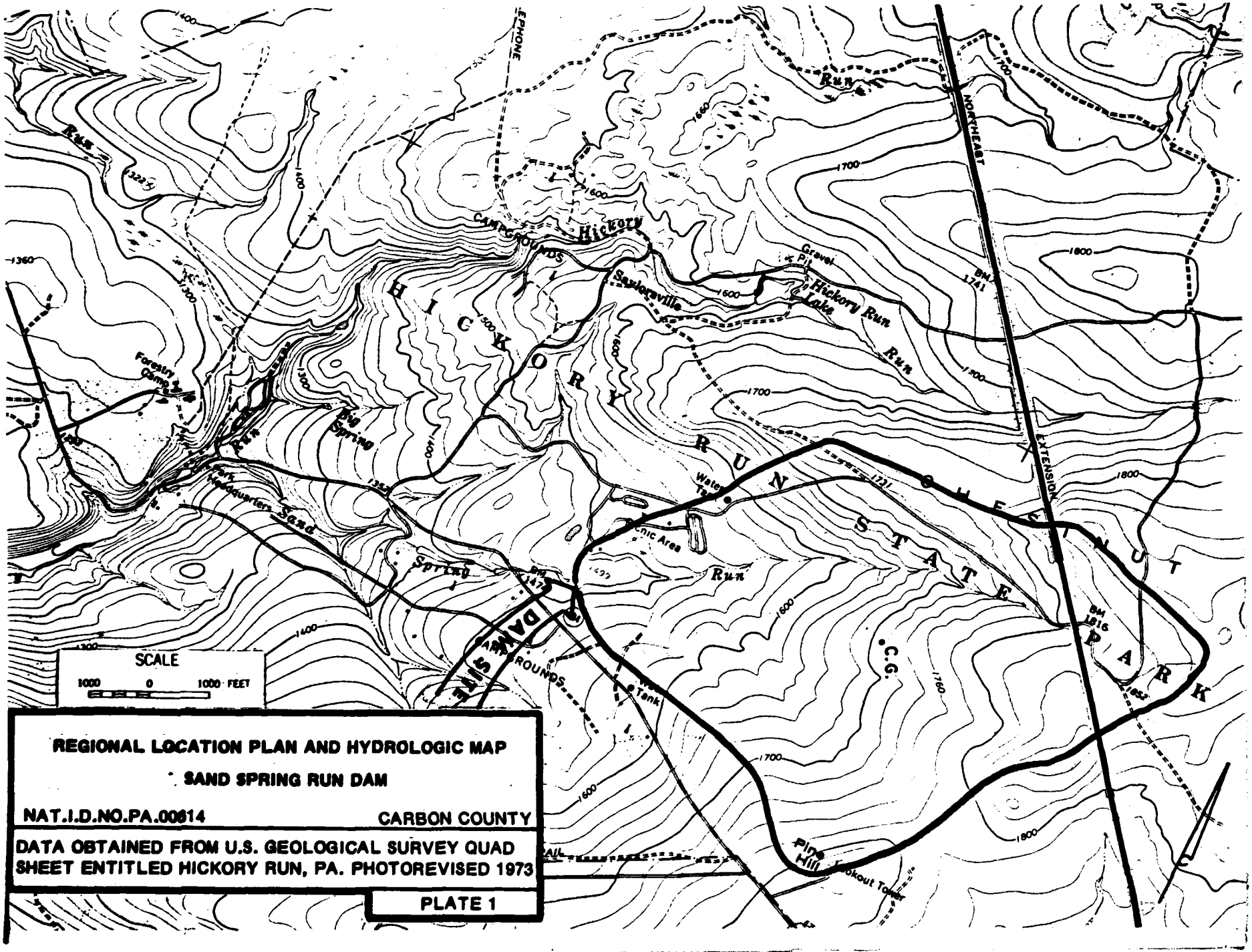
	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1500.00	1500.00	1506.40
STORAGE	45.	45.	139.
OUTFLOW	0.	0.	5414.

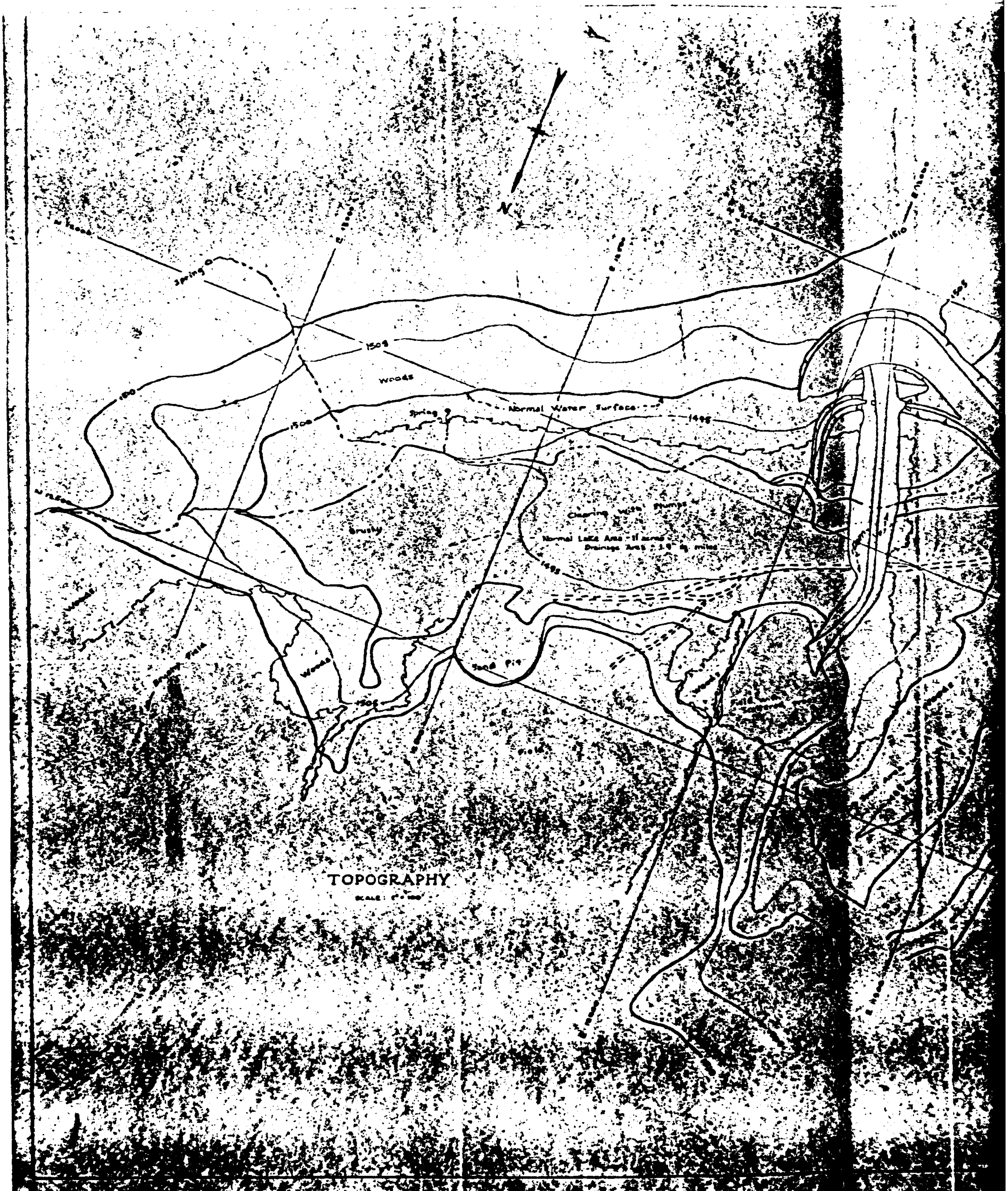
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1502.57	0.00	77.	1381.	0.00	42.50	0.00
.60	1502.91	0.00	82.	1657.	0.00	42.50	0.00
.70	1503.22	0.00	86.	1934.	0.00	42.50	0.00
1.00	1504.09	0.00	99.	2765.	0.00	42.50	0.00

SHEET 6 OF 9

APPENDIX

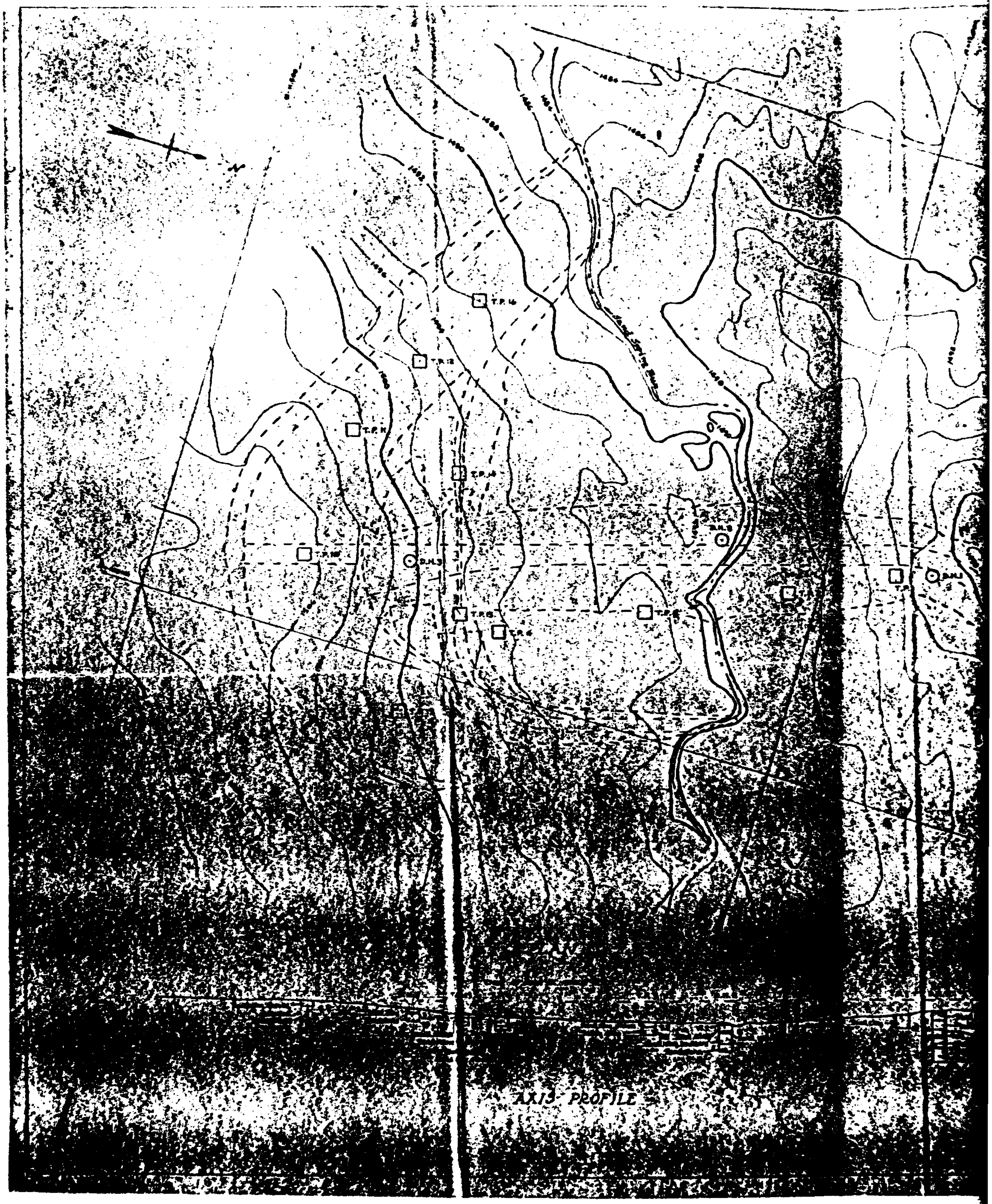
E


HICKORY RUN STATE PARK
CAMPGROUNDS
Hickory Run
Saylorsville
Gravel Pit
Hickory Run Lake
Run
Big Spring
Forestry Camp
Park Headquarters
Sand Spring
DAM SITE
Water Tank
Picnic Area
C.G.
Pine Hill
Lookout Tower
NORTHEAST EXTENSION
PHONE
SCALE
1000 0 1000 FEET
REGIONAL LOCATION PLAN AND HYDROLOGIC MAP
SAND SPRING RUN DAM
NAT.I.D.NO.PA.00614
CARBON COUNTY
DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY QUAD SHEET ENTITLED HICKORY RUN, PA. PHOTOREVISED 1973
PLATE 1


N
Spring
1509
Woods
1500
Spring
Normal Water Surface
1495
1510
Brushy
Sand Pit
TOPOGRAPHY

25 miles to Wilkes Barre
White Haven
East Side
Kidder Township
Hickory Run SITE
12 miles to Hazleton
Sand Spring Run
Hickory Run Park
Mud Run
Penn Forest Township
LOCATION MAP
Sand Spring Run
Brushy Field
Woods
BORROW AREA LOCATION MAP
REVISED
THE GENERAL STATE AUTHORITY
APPROVED
SUBMITTED
ACCEPTED
SAND SPRING RUN DAM
TOPOGRAPHY
DATE 5-22-90

PLATE 2


AXIS PROFILE

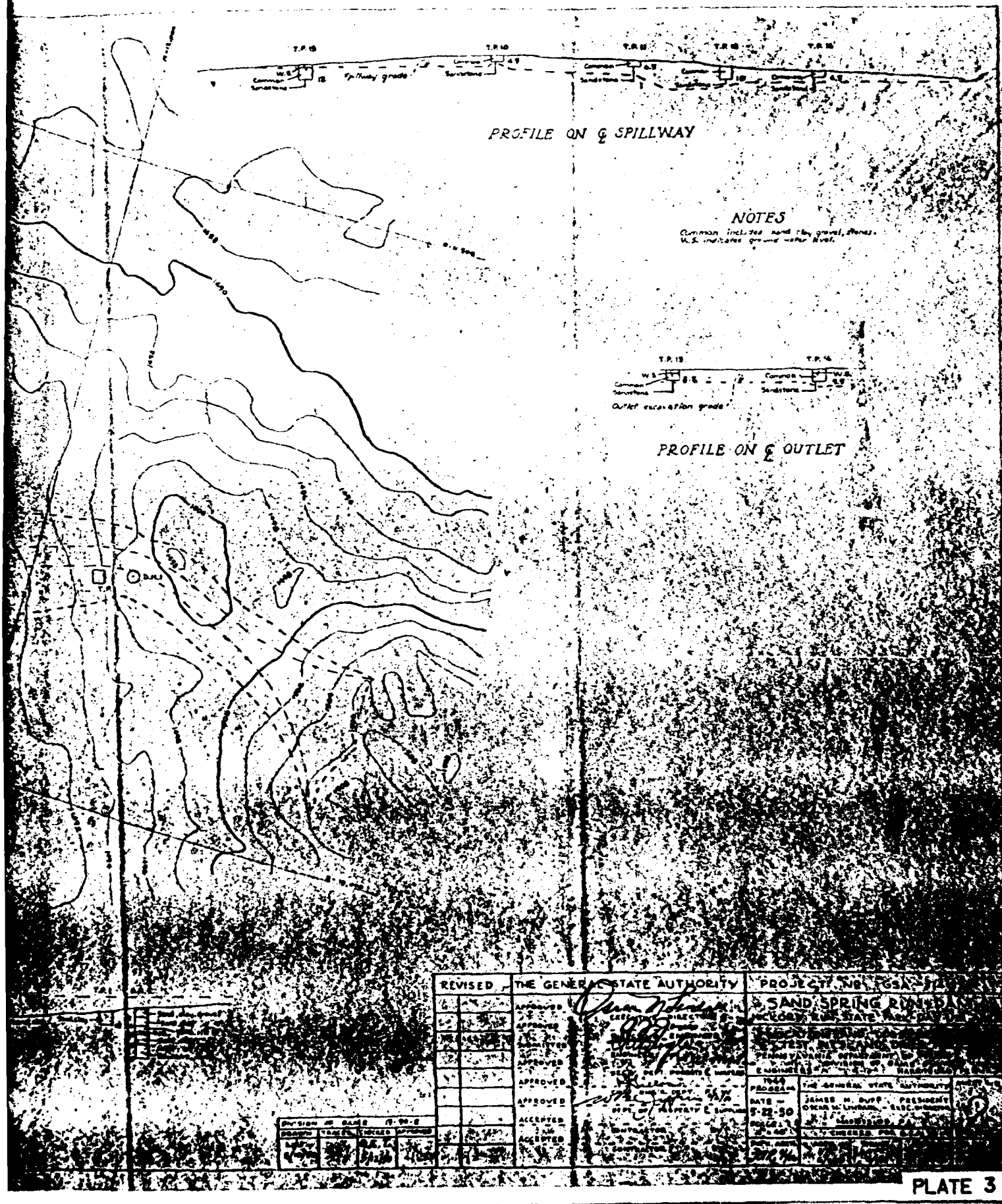
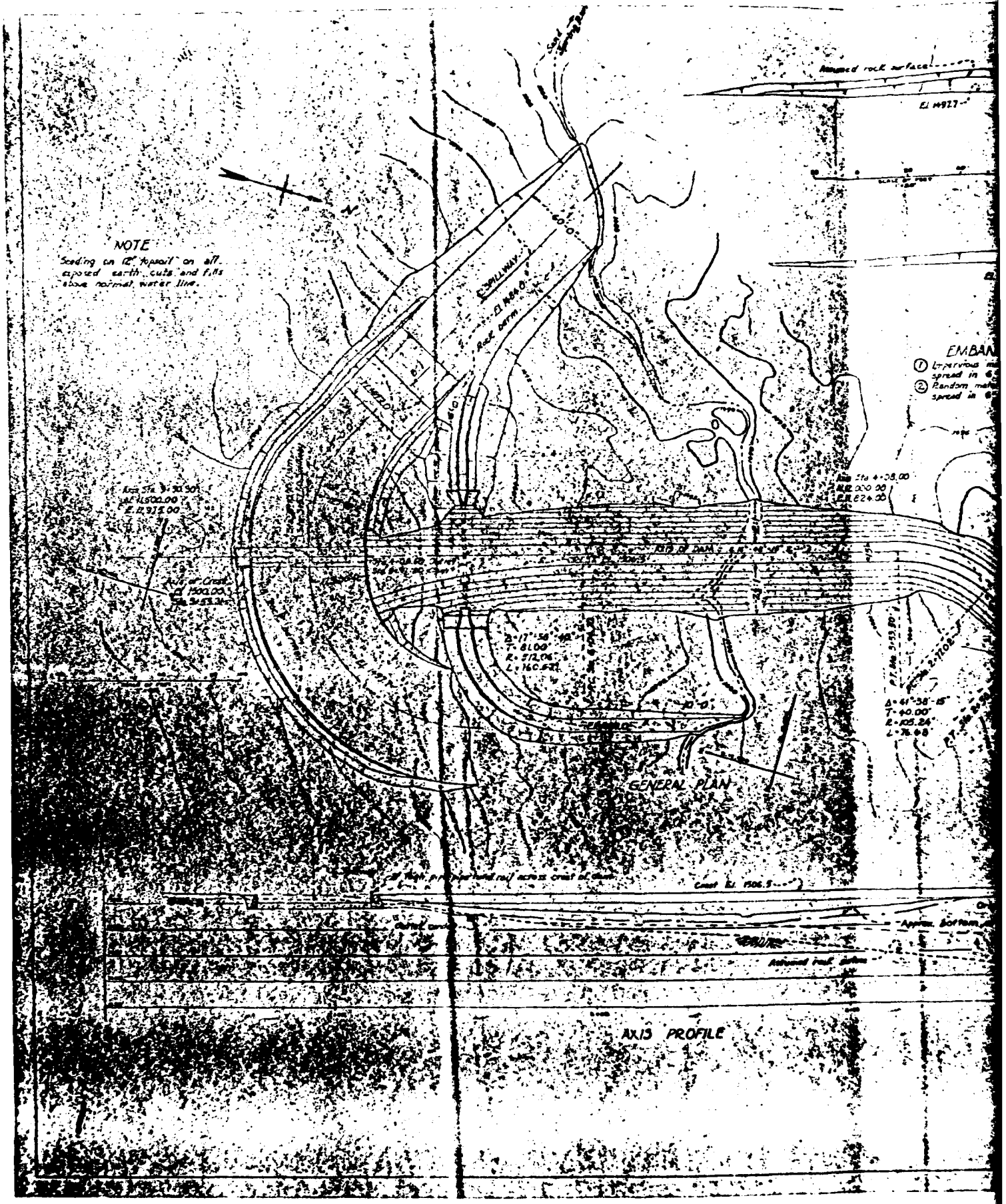

T.P.13
T.P.14
T.P.15
T.P.16
T.P.17
Common
Sandstone
W.S.
Spillway grade
PROFILE ON ℄ SPILLWAY
NOTES
Common includes sand, clay, gravel, stones.
W.S. indicates ground water level.
T.P.13
T.P.14
W.S.
Common
Sandstone
Outlet excavation grade
PROFILE ON ℄ OUTLET
DAM
REVISED
THE GENERAL STATE AUTHORITY
APPROVED
APPROVED
APPROVED
APPROVED
APPROVED
ACCEPTED
ACCEPTED
PROJECT NO. GSA
SAND SPRING RUN DAM
1949
DATE
5-22-50
JAMES H. DUFF, PRESIDENT
THE GENERAL STATE AUTHORITY

PLATE 3


NOTE
Seeding on 12" topsoil on all exposed earth cuts and fills above normal water line.
EMBAN
GENERAL PLAN
AXIS PROFILE

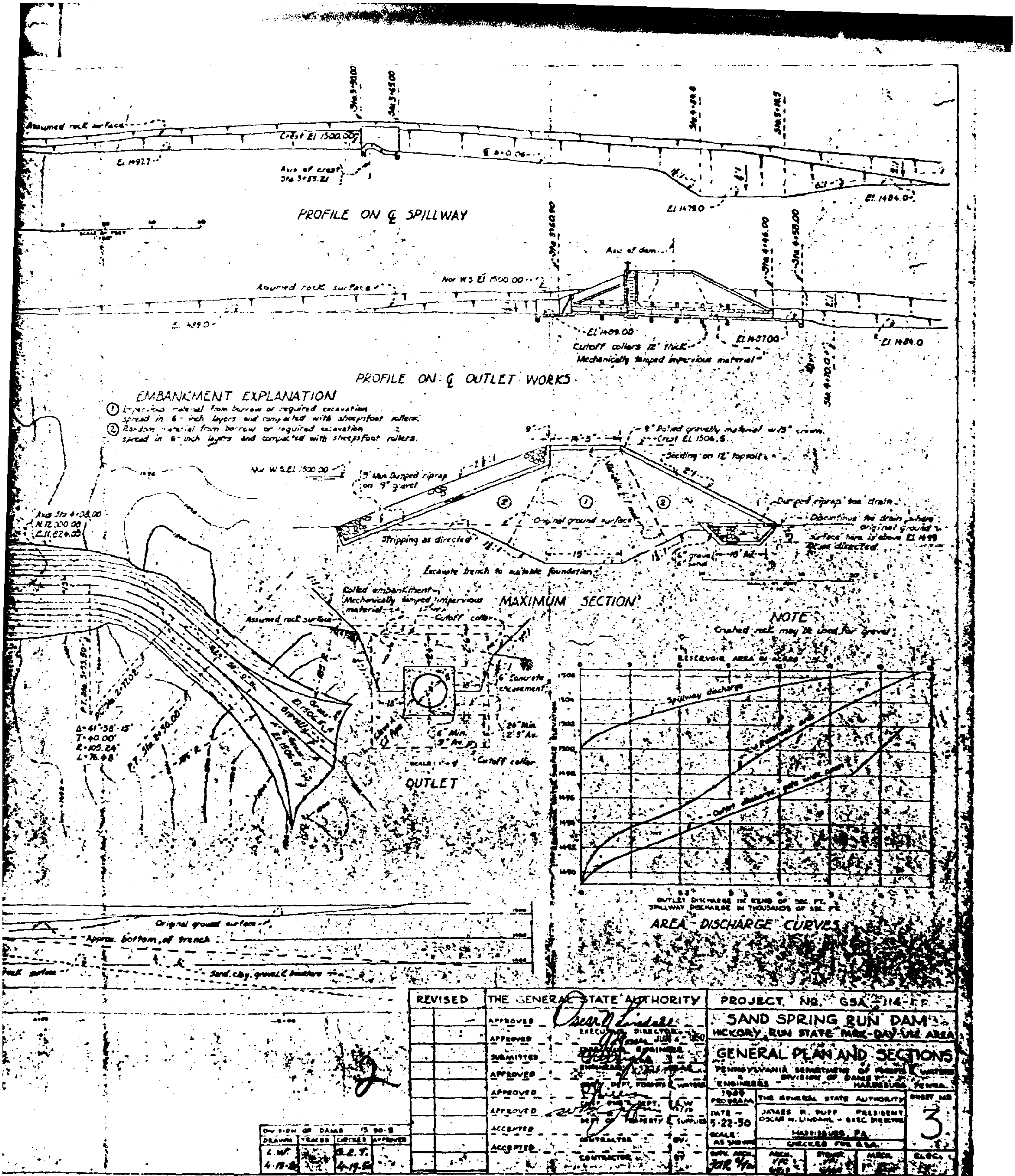
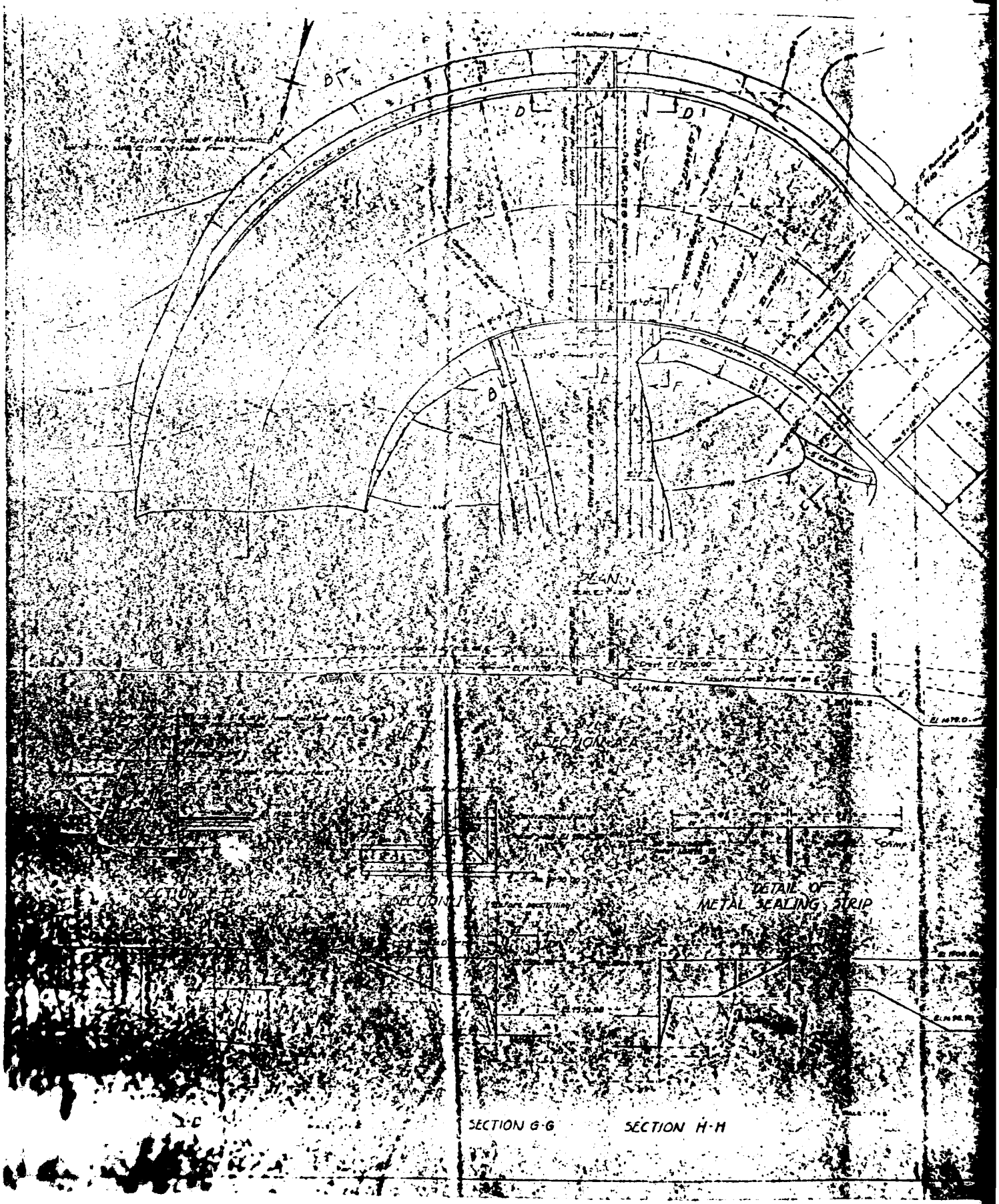
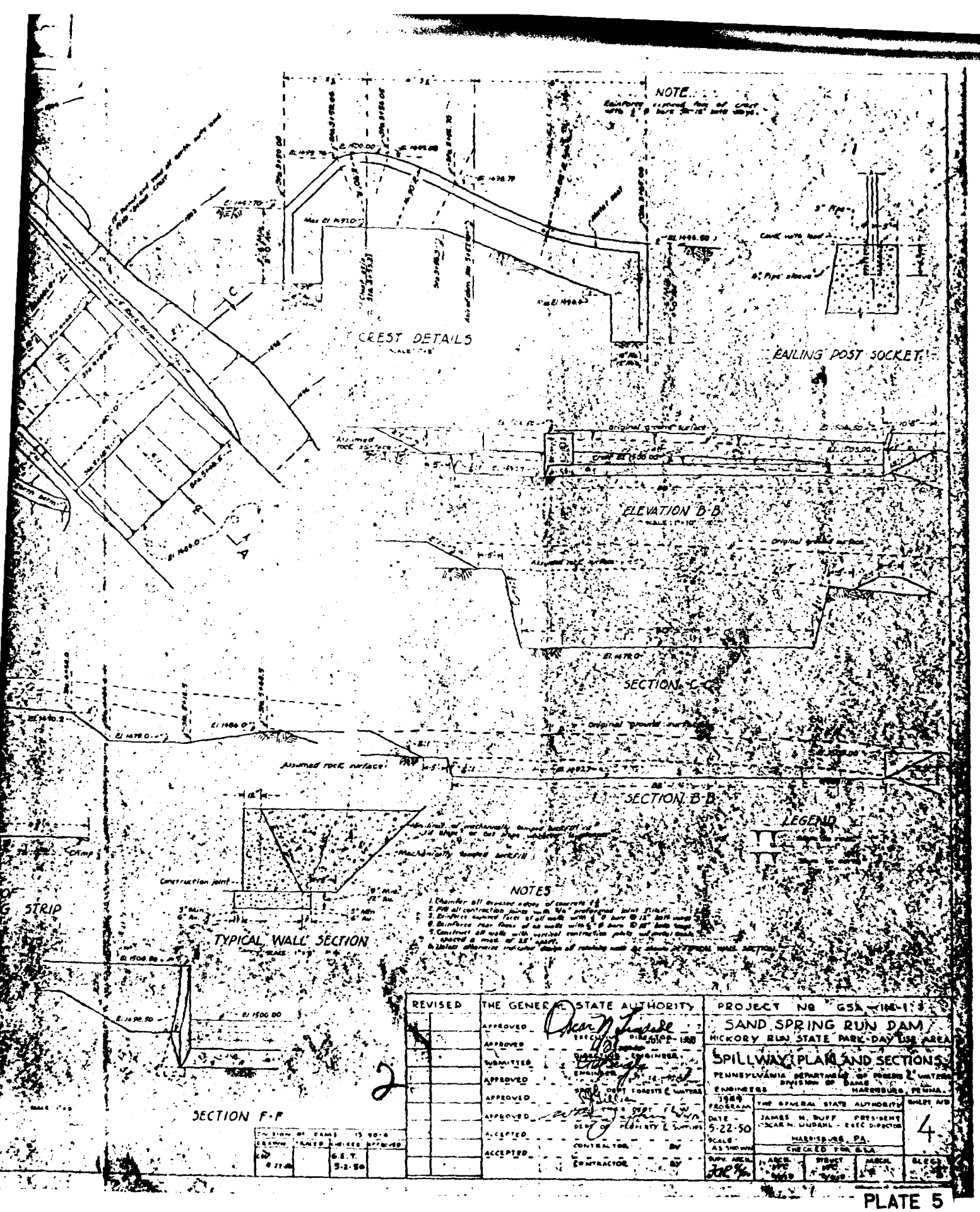

PROFILE ON ℄ SPILLWAY
Assumed rock surface
Crest El 1500.00
Axis of crest Sta 3+53.21
El 1492.7
El 1478.0
El 1484.0
PROFILE ON ℄ OUTLET WORKS
Axis of dam
Nor W.S. El 1500.00
Assumed rock surface
El 1489.0
El 1489.00
El 1487.00
El 1484.0
Cutoff collars 12" thick
Mechanically tamped impervious material
EMBANKMENT EXPLANATION
(1) Impervious material from borrow or required excavation spread in 6-inch layers and compacted with sheepsfoot rollers.
(2) Random material from borrow or required excavation spread in 6-inch layers and compacted with sheepsfoot rollers.
9" Rolled gravelly material w/ 15" crown
Crest El 1506.5
Seeding on 12" topsoil
3' Min Dumped riprap on 9" gravel
Original ground surface
Stripping as directed
Dumped riprap toe drain
Discontinue toe drain where original ground surface here is above El 1499 or as directed
Excavate trench to suitable foundation
MAXIMUM SECTION
Rolled embankment
Mechanically tamped impervious material
Cutoff collar
Assumed rock surface
6" Concrete encasement
24" Min 2'-5" Av.
6" Min 9" Av.
Cutoff collar
OUTLET
NOTE
Crushed rock may be used for gravel
Axis Sta 4+08.00
N.12,000.00
E.11,824.00
Δ-41°38'-15"
T-40.00'
R-105.24'
L-76.48'
RESERVOIR AREA IN ACRES
Spillway discharge
OUTLET DISCHARGE IN TENS OF SEC. FT.
SPILLWAY DISCHARGE IN THOUSANDS OF SEC. FT.
AREA-DISCHARGE CURVES
Original ground surface
Approx. bottom of trench
Sand, clay, gravel & boulders
REVISED
THE GENERAL STATE AUTHORITY
APPROVED
SUBMITTED
ACCEPTED
CONTRACTOR
PROJECT NO. GSA 114
SAND SPRING RUN DAM
HICKORY RUN STATE DAY-USE AREA
GENERAL PLAN AND SECTIONS
PENNSYLVANIA DEPARTMENT OF FORESTS & WATERS
DIVISION OF DAMS
HARRISBURG, PENNA.
1949 PROGRAM
DATE 5-22-50
SCALE: AS SHOWN
THE GENERAL STATE AUTHORITY
JAMES R. DUFF PRESIDENT
OSCAR M. LINDAHL - EXEC. DIRECTOR
HARRISBURG, PA.
CHECKED FOR G.S.A.
3
DIVISION OF DAMS
DRAWN
TRACED
CHECKED
APPROVED
4-19-50

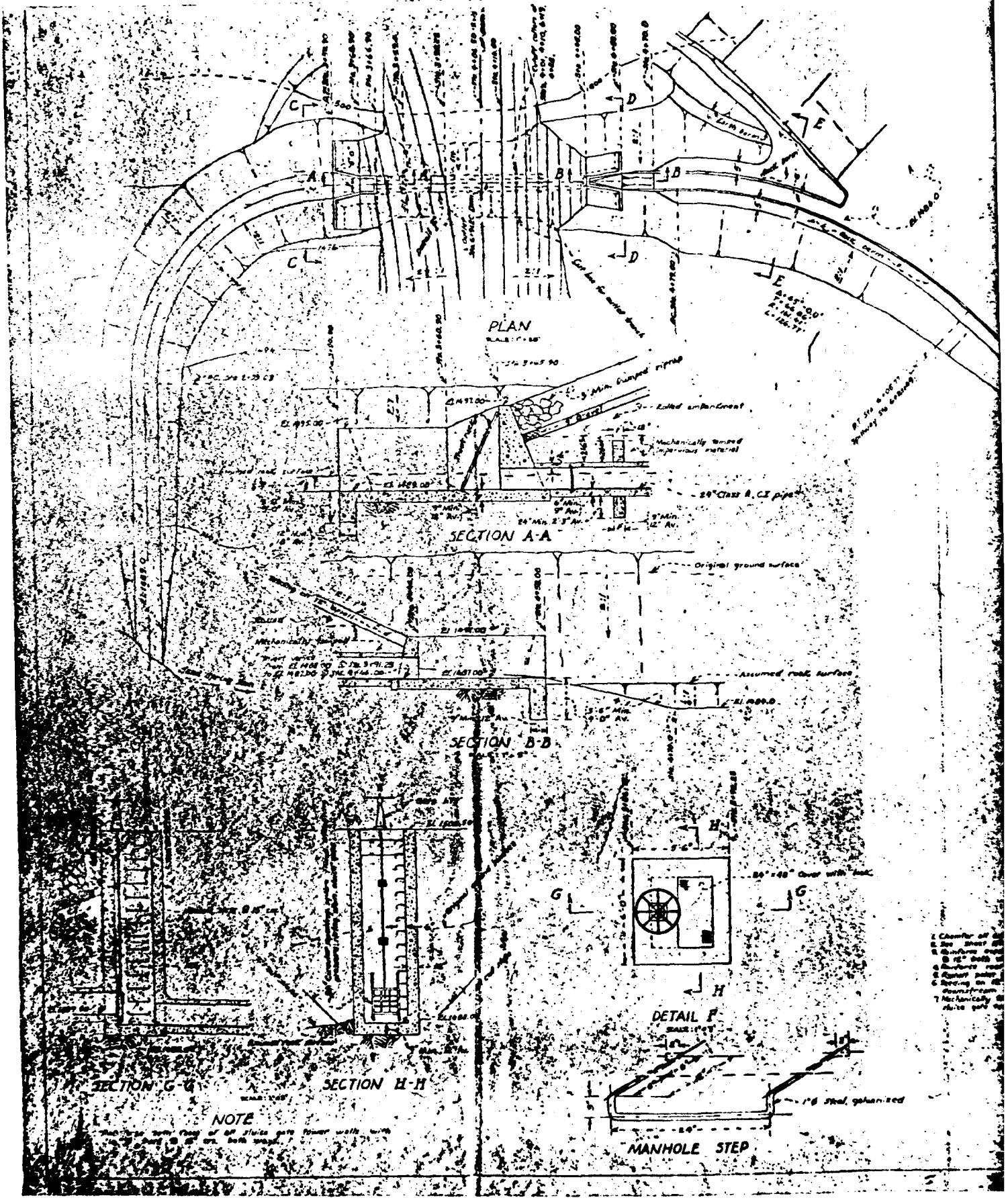
PLATE 4

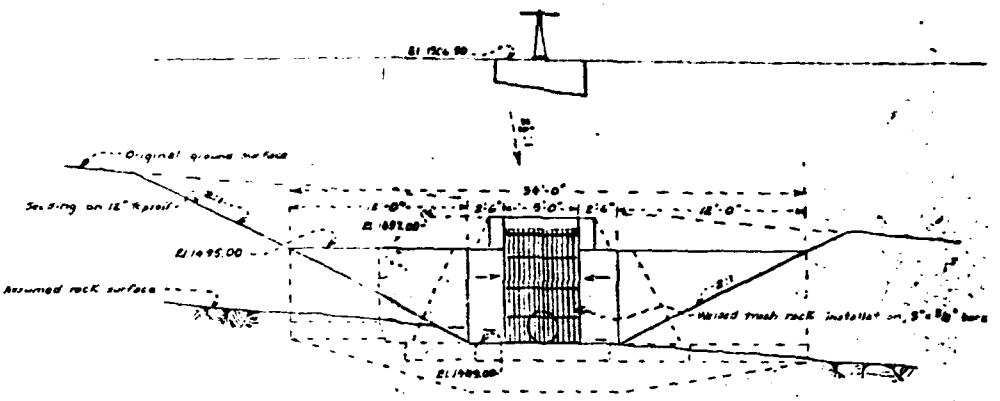

SECTION A-A
DETAIL OF METAL SEALING STRIP
SECTION G-G
SECTION H-H



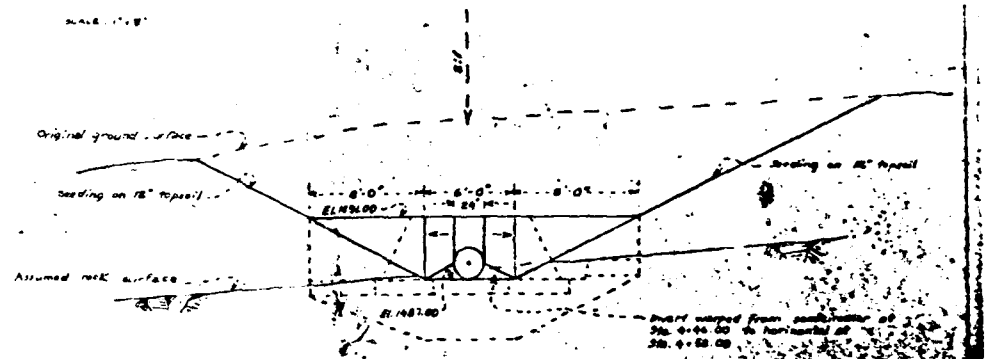
REVISED	THE GENERAL STATE AUTHORITY	PROJECT NO GSA-[illegible]-1.3
	APPROVED — DIRECTOR — 1950	SAND SPRING RUN DAM
	APPROVED — DIRECTOR — ENGINEER	HICKORY RUN STATE PARK-DAY USE AREA
	SUBMITTED — ENGINEER	SPILLWAY PLAN AND SECTIONS
	APPROVED — STATE DEPT FORESTS & WATERS	PENNSYLVANIA DEPARTMENT OF FORESTS & WATERS DIVISION OF DAMS
	APPROVED — DEPT OF PUBLIC WORKS	ENGINEERS HARRISBURG, PENNA.
	APPROVED — DEPT OF PUBLIC WORKS	1950 PROGRAM — THE GENERAL STATE AUTHORITY — SHEET NO 4
	ACCEPTED — CONTRACTOR	DATE 5-22-50 — JAMES M. DUFF PRESIDENT, OSCAR N. LINDAHL EXEC DIRECTOR
	ACCEPTED — CONTRACTOR	SCALE AS SHOWN — HARRISBURG, PA.
		SUPV. AREA Joe % — CHECKED FOR G.S.A.

PLATE 5

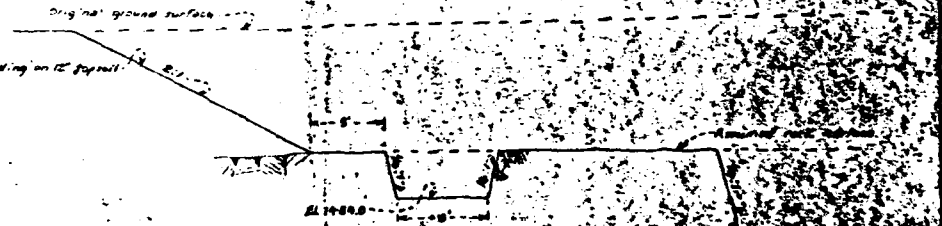

PLAN
SECTION A-A
SECTION B-B
SECTION G-G
SECTION H-H
DETAIL F
MANHOLE STEP
NOTE



SECTION C C



SECTION D-D



SECTION E-E

NOTES

1. Chamfer all exposed edges of concrete 1½".
2. See sheet 6 for typical wall section.
3. Reinforce exposed faces of all walls and paving with ½" ϕ bars @ 12" both ways.
4. Reinforce rear faces of all walls with ½" ϕ bars @ 12" both ways.
5. Reinforce paving at all contraction joints.
6. Seeding on 12" topsoil on all exposed earth cuts and fills downstream from dam crest.
7. Mechanically tamp impervious material within three feet of sluice gate tower walls.

DIVISION OF DAMS			
DRAWN	TRACED	CHECKED	APPROVED
LWJ 5/19/50		G.R.F. 5/24/50	

REVISED	THE GENERAL STATE AUTHORITY	PROJECT NO GSA-116-1
	APPROVED — Executive Director	SAND SPRING RUN DAM
	APPROVED — Chief Engineer	HICKORY RUN STATE PARK-DAY USE AREA
	SUBMITTED — Engineer	OUTLET PLAN AND SECTIONS
	APPROVED — Dept. Forests & Waters	PENNSYLVANIA DEPARTMENT OF FORESTS & WATERS
	APPROVED — Gen'l Supt. F&W	DIVISION OF DAMS
	APPROVED — Dept. of Property & Supplies	ENGINEERS HARRISBURG, PENNA.
	ACCEPTED — Contractor BY	1949 PROGRAM — THE GENERAL STATE AUTHORITY — SHEET NO 5
	ACCEPTED — Contractor BY	DATE — 5-22-50 — JAMES H. DUFF PRESIDENT, OSCAR W. LINDAHL EXEC. DIRECTOR
		SCALE: AS SHOWN — HARRISBURG, PA.
		CHECKED FOR G.S.A.

PLATE 6

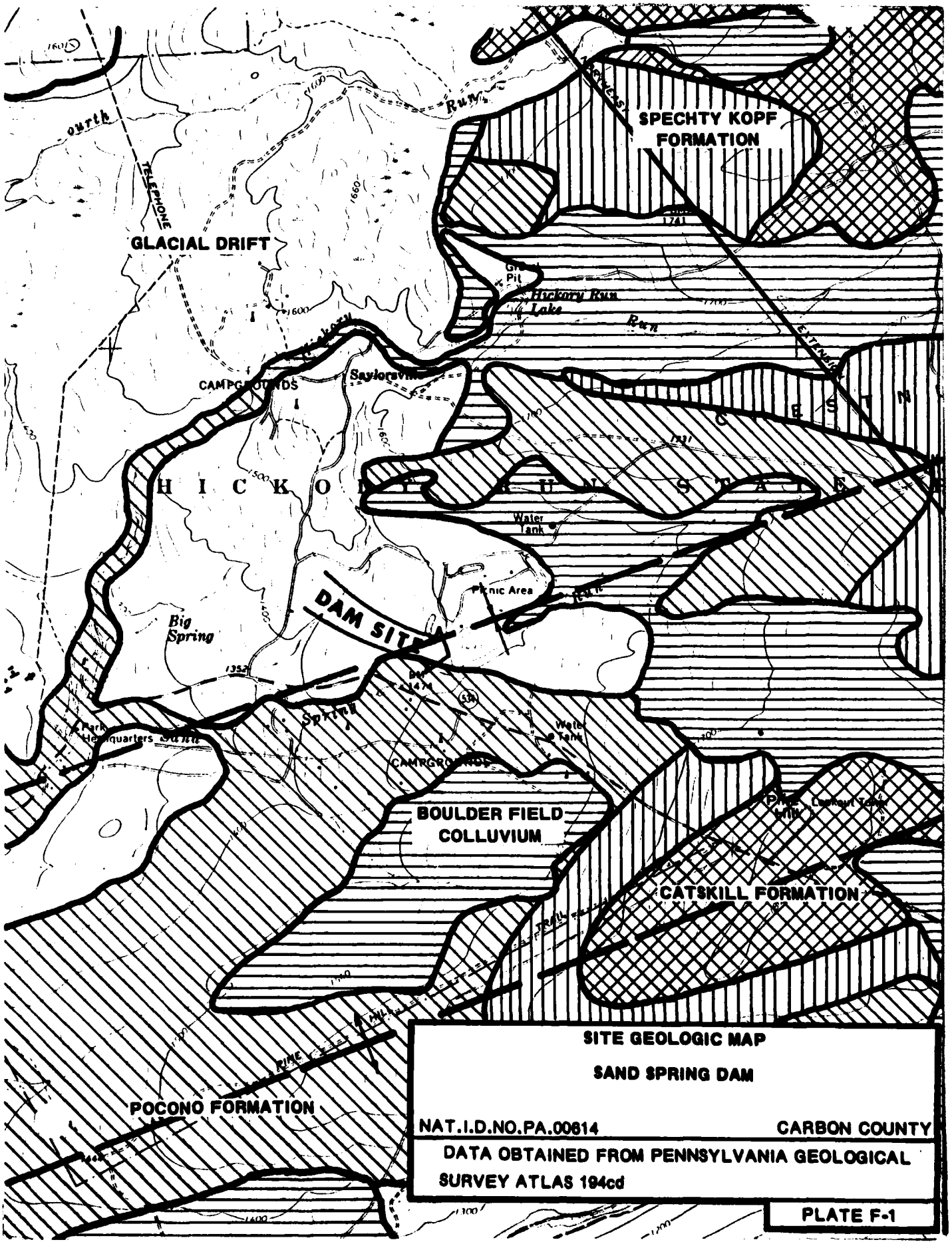
APPENDIX

F

SITE GEOLOGY
SAND SPRING DAM

Sand Spring Dam is located in the Pocono Plateau Section of the Appalachian Plateau Physiographic Province. As shown in Plate F-1, the dam site is underlain by glacial drift of Pleistocene age which overlies the sandstone bedrock of the Mississippian age Pocono Formation. The glacial deposits observed in the northern part of the dam site area consists of stratified drifts composed of sand, gravel and cobbles having clayey or silty sand matrix. This material was approximately six to eight feet thick in an exposure near the dam toe along the right bank of Sand Spring Run and as reported in state files may be in excess of 60 feet thick in the right abutment area. The unstratified glacial drift found in the southern part of the dam site area consists of till composed of clay to boulder size material.

Bedrock outcrops were limited to, but well exposed, downstream of the spillway along the entire width of the spillway. Here the gray fine to medium grained sandstone strikes north-northeast (approximately perpendicular to the dam centerline) and dips moderately to the northwest. The axis of a concealed northeast trending syncline passes near the right abutment area of the dam as indicated by state geologic mapping. A well developed system of high angle jointing strikes to the northeast and northwest. The northeasterly striking and open bedding and jointing planes would be possible avenues of groundwater seepage.


SPECHTY KOPF FORMATION
GLACIAL DRIFT
Hickory Run Lake
Run
CAMPGROUNDS
Saylorsville
Water Tank
Picnic Area
DAM SITE
Big Spring
Spring
Park Headquarters
CAMPGROUNDS
Water Tank
BOULDER FIELD COLLUVIUM
CATSKILL FORMATION
POCONO FORMATION
TELEPHONE
PINE
SITE GEOLOGIC MAP
SAND SPRING DAM
NAT.I.D.NO.PA.00614
CARBON COUNTY
DATA OBTAINED FROM PENNSYLVANIA GEOLOGICAL SURVEY ATLAS 194cd
PLATE F-1


DAT
FILM
2